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United States Department of Agriculture

Food and Nutrition Service

Office of Analysis and Evaluation

Estimation of Eligibility for the WIC Program

Report of the WIC Eligibility Study

Technical Appendixes

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The research reported here was carried out under contract number 53-3198-3-138 of the U.S. Department of Agriculture, Food and Nutrition Service, by Sigma One Corporation, 3300 Drake Circle, Raleigh, North Carolina 27607.

Dr. David L. Franklin and Marielouise W. Harrell, Sigma One, developed the estimation models used in the study. Harrell performed all estimations and the statistical determination of the weighted modal set of State WIC nutritional-risk criteria.

Dr. Cutberto Parillon, M.D., former Director of Nutrition, Ministry of Health in the Government of Panama, assisted in interpreting the medical and dietary data sets and in constructing the nutritional-risk indicator variables from the survey data corresponding to the modal WIC criterion levels for nutritional risk.

The study Advisory Panel provided essential advice in the design phase of the project and following an initial round of preliminary estimation results. The Panelists were:

Dr. George H. Beaton, Faculty of Medicine, University of Toronto;
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Stefan Harvey, Center on Budget and Policy Priorities, Washington, DC;
Dr. Jerianne Heimendinger, Northeastern Regional Office, FNS, (former Director of Nutrition Services, Rhode Island Department of Health);
Dr. Sandra Huffman, Department of International Health, Johns Hopkins University;
Sheryl Lee, MPH, RD, Chief, Bureau of Nutrition Services, Arizona Department of Health;
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Dr. Noel Solomons, Department of Nutrition, Massachusetts Institute of Technology
Faye Wong, Division of Nutrition, Centers for Disease Control, U.S. Public Health Service; and
Nancy Zinneman, MPH, Chief, Nutrition Section, Connecticut Department of Health Services.

Dr. Jean-Pierre Habicht, Cornell University, provided comment on the design of the nutritional-risk estimation model.

Dr. Gary W. Bickel, FNS Office of Analysis and Evaluation, was Project Officer for the WIC Eligibility Study and authored the final report. Leighton C. Ku, Office of Analysis and Evaluation, contributed substantially to the final form of the update projection model used in the study. Close critical reading of all drafts was provided by Mr. Ku and by Clara L. French of the FNS Supplemental Food Programs Division. Catherine M. Brown and Shirley Hutchens of the FNS/OAE staff carried out production of the final report. Estelle Cantwell of Kind Words, 12918 Clifton Creek Drive, Clifton, Virginia 22024, produced the Technical Appendix volume of the report.

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PREFACE

The present volume of technical appendixes has been prepared by the Food and Nutrition Service (FNS) to accompany the Report of the WIC Eligibility Study: Summary of Data, Method, and Findings, completed in July 1987. It is expected that this technical descriptive material and backup data will be of interest primarily to researchers or others interested in the detailed estimation procedures used and statistical results obtained in the WIC Eligibility Study.

These appendixes include detailed results from the estimations of nutritional-risk frequency carried out in the study for each WIC target population group. They also present nutritional-risk-indicator data from the Second National Health and Nutrition Examination Survey (NHANES-II, 1976-80) and the National Natality/National Fetal Mortality Surveys (NNS, 1980). More complete operational definitions of the modal set of medical and dietary risk criteria set by WIC State agencies for determining the nutritional-risk status of WIC applicants, and hence their program eligibility, are provided here than are included in the main report.

Detailed data and methods for the update projection model used in the study will be available subsequently when the estimated national levels of WIC Program eligible population for 1986 are reported. This model was used in the present report to project the estimated 1984 levels of WIC-eligible population from the 1979 baseline estimates.

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A third volume of the WIC Eligibility Study presents the detailed estimates of WIC eligible population by State and county for the 1979 baseline period. The State and county estimates are not updated to more current levels, since consistent current income data, necessary to make valid projections from the baseline estimates, are not available for these geographic levels.

The three volumes of the Report of the WIC Eligibility Study are subtitled:

- Summary of Data, Method, and Findings
- Technical Appendixes
- Detailed State and County 1979 Baseline Estimates.

  Part A -- States

  Part B -- Counties

Additional copies of these volumes are available from:

National Technical Information Service
5285 Port Royal Drive
Springfield, VA 22161
(703) 487-4650

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APPENDIX A

SPECIFICATION OF THE EXTRACT FILE FROM THE 1980 U.S. CENSUS OF POPULATION AND HOUSING

The special Census data extract for the WIC Eligibility Study was prepared for the Food and Nutrition Service (FNS) by the U.S. Bureau of the Census, Population Division, Administrative Records Branch, under the direction of Douglas Sater.

The required data were provided to FNS on five computer tapes. Two of these contain the counts of women, infants, and children in the 50 States and the District of Columbia, by county and Standard Metropolitan Statistical Area (SMSA). The counts are subdivided by age, race and Hispanic identity, and household income/poverty level. Older children, as well as those below age 5, are included. The poverty-income definition used in Census Bureau statistical work and in reporting census and current Population Survey U.S. population data by income/poverty level is used here, rather than the DHHS/OMB Poverty Guideline definition.

The remaining three tapes provide the same data for 448 U.S. Indian Reservations and adjacent Tribal Trust Areas, for Puerto Rico and its Municipios (comparable to U.S. counties), and for Guam and the U.S. Virgin Islands.

Technical specifications for three of the tapes are presented here. Copies of all five tapes are available from the National Technical Information Service.

WOMEN, INFANTS, AND CHILDREN - U.S. FILE - FIRST OF TWO TAPES

TECHNICAL SPECIFICATIONS

The tape is IBM formatted, unlabeled, 9-track, odd parity, 1600 BPI. There are 2940 EBCDIC characters per record and 4 records per block (11760 characters). There is an initial tape mark followed by data, followed by two tape marks.

DATA DESCRIPTION

There is one record per geographic unit, with each record containing three tables. The records are sorted by SMSA and county within FIPS State.

State 01
  SMSA 0450
  .
  .
  .
  SMSA 8600
  County 001
  .
  .
  .
  County 133
State 02
.
.
.
State 56

Table 1 consists of all persons under 19 years old, by age, race, and levels of poverty. Table 2 is deleted on this tape. Table 3 consists of women with own children under 9 months old, by age, race, and poverty levels. Table 1 uses the standard Census definition of poverty, while table 3 uses the family

size minus one for determining poverty status. All counts contained in the two tables are weighted sample counts of the 1980 Census.

Due to the confidentiality policies of the Census Bureau, any geographic unit with a sample population of 1-29 will have its data suppressed; in addition, any race totals or Spanish-origin population of 1-29 will cause the data describing that race to be suppressed.

CHARACTERS	FIELD
1-2	Type 1=US Level 2=State Level 3=County 4=Puerto Rico 5=Municipio 6=Virgin Island 7=Guam 8=Indian Reservation 9=Adjacent Trust Land 10=SMSA
3-4	State 00=US 01-56=FIPS State code
4-8	SMSA 4-digit SMSA code
9-11	County/Municipio 3-digit county code
12-14	Indian Reservation/Trust Land 3-digit reservation code
15-15	Suppression flag for total population 0=data describing this population is not suppressed 1=data describing this population is suppressed

16-16	Suppression flag for non-Hispanic, white population 0=data describing this population is not suppressed 1=data describing this population is suppressed
17-17	Suppression flag for non-Hispanic, black population 0=data describing this population is not suppressed 1=data describing this population is suppressed
18-18	Suppression flag for non-Hispanic, Native American population 0=data describing this population is not suppressed 1=data describing this population is suppressed
19-19	Suppression flag for non-Hispanic, Asian, Pacific population 0=data describing this population is not suppressed 1=data describing this population is suppressed
20-20	Suppression flag for Hispanic population 0=data describing this population is not suppressed 1=data describing this population is suppressed
21-24	Filler (space-filled)
25-60	Name of geographic unit

WOMEN, INFANTS, AND CHILDREN - U.S. FILE - FIRST OF TWO TAPES

Table 1

	Poverty universe
	All races
61-68	Under 1 year old
69-76	1 year old
77-84	2 years old
85-92	3 years old
93-100	4 years old
101-108	5 years old
109-116	6-12 years old
117-124	13-18 years old
125-188	White, non-Hispanic
189-252	Black, non-Hispanic
253-316	Native American, non-Hispanic
317-380	Asian, Pacific, non-Hispanic
381-444	Hispanic
445-828	Below 100% of poverty level
829-1212	Below 130% of poverty level
1213-1596	Below 185% of poverty level

Table 2 - Deleted

Table 3

	Poverty universe
	All races
	Women with own children under 9 months of age
2173-2180	Under 19 years old
2181-2188	19-26 years old
2189-2196	27-35 years old
2197-2204	36 years and over
2205-2236	White, non-Hispanic
2237-2268	Black, non-Hispanic
2269-2300	Native American, non-Hispanic
2301-2332	Asian, Pacific, non-Hispanic
2333-2364	Hispanic
2365-2556	Below 100% of poverty level
2557-2748	Below 130% of poverty level
2749-2940	Below 185% of poverty level

WOMEN, INFANTS, AND CHILDREN - U.S. FILE - SECOND OF TWO TAPES

TECHNICAL SPECIFICATIONS

The tape is IBM formatted, unlabeled, 9-track, odd parity, 1600 BPI. There are 2364 EBCDIC characters per record and 4 records per block (9456 characters). There is an initial tape mark followed by 889 blocks (3553 records), followed by 2 tape marks.

DATA DESCRIPTION

There is one record per geographic unit, with each record containing three tables. The records are sorted by SMSA and county within FIPS State.

State 01
  SMSA 0450
  .
  .
  .
  SMSA 8600
  County 001
  .
  .
  .
  County 133
State 02
.
.
.
State 56

Table 1 and table 3 are filed on another tape. Table 2 consists of women by age, by age of own children, by race, and by levels of poverty. Table 2 uses the standard Census definition of poverty. All counts contained in the table are weighted sample counts of the 1980 Census.

WOMEN, INFANTS, AND CHILDREN - U.S. FILE - SECOND OF TWO TAPES

Due to the confidentiality policies of the Census Bureau, any geographic unit with a sample population of 1-29 will have its data suppressed; in addition, any race totals or Spanish-origin population of 1-29 will cause the data describing that race to be suppressed.

CHARACTERS	FIELD
1-2	Type 1=US total 2=State Level 3=County 4=Puerto Rico 5=Municipio 6=Virgin Island 7=Guam 8=Indian Reservation 9=Adjacent Trust Land 10=SMSA
3-4	State 00=US 01-56=FIPS State code
5-8	SMSA 4-digit SMSA code
9-11	County, Municipio 3-digit county code
12-14	Indian Reservation/Trust Land 3-digit reservation code
15-15	Suppression flag for total population 0=data describing this population is not suppressed 1=data describing this population is suppressed
16-16	Suppression flag for non-Hispanic, white population 0=data describing this population is not suppressed 1=data describing this population is suppressed
17-17	Suppression flag for non-Hispanic, black population 0=data describing this population is not suppressed 1=data describing this population is suppressed

WOMEN, INFANTS, AND CHILDREN - U.S. FILE - SECOND OF TWO TAPES

18-18	Suppression flag for non-Hispanic, Native American population 0=data describing this population is not suppressed 1=data describing this population is suppressed
19-19	Suppression flag for non-Hispanic, Asian, Pacific population 0=data describing this population is not suppressed 1=data describing this population is suppressed
20-20	Suppression flag for Hispanic population 0=data describing this population is not suppressed 1=data describing this population is suppressed
21-24	Filler (space-filled)
25-60	Name of geographic unit

Table 2

	Poverty universe
	All races
	Under 19 years old
61-68	Women with own children under 6 months
69-76	Women with own children under 12 months
77-84	All women
85-108	19-26 years old
109-132	27-35 years old
133-156	36 years and over
157-252	White, non-Hispanic
253-348	Black, non-Hispanic
349-444	Native American, non-Hispanic
445-540	Asian, Pacific, non-Hispanic
541-636	Hispanic
637-1212	Below 100% of poverty level
1213-1788	Below 130% of poverty level
1789-2364	Below 185% of poverty level

WOMEN, INFANTS, AND CHILDREN - INDIAN RESERVATIONS

TECHNICAL SPECIFICATIONS

The tape is IBM formatted, unlabeled, 9-track, odd parity, 1600 BPI. There are 4668 EBCDIC characters per record and 4 records per block (18672 characters). There is an initial tape mark followed by 273 blocks (1091 records), followed by 2 tape marks.

DATA DESCRIPTION

There is one record per geographic unit, with each record containing three tables. The records are sorted by reservation and reservation county part.

```
Reservation 3 total
   State 35, county 61 part
Reservation 5 total
   State 6, county 61 part
   .
   .
Reservation 113 total
   State 16, county 73 part
   State 32, county 7 part
   .
   .
Reservation 995 total
   State 2, county 231 part
```

Table 1 consists of all persons under 19 years old by age, race, and by levels of poverty. Table 2 consists of women by age of own children, by age, race, and levels of poverty. Table 3 consists of women with own children under 9 months old by age, race, and by poverty levels. Tables 1 and 2 use the standard Census definition of poverty, while table 3 uses the family size

minus one for determining poverty status. All counts contained in the three tables are weighted sample counts of the 1980 Census.

Due to the confidentiality policies of the Census Bureau, any geographic unit with a sample population of 1-29 will have its data suppressed; in addition, any race totals or Spanish-origin population of 1-29 will cause the data describing that race to be suppressed.

CHARACTERS	FIELD
1-2	Type 1=US Level 2=State Level 3=County 4=Puerto Rico 5=Municipio 6=Virgin Island 7=Guam 8=Indian Reservation 9=Adjacent Trust Land 10=SMSA
3-4	State 00=Reservation total 01-56=FIPS State code
5-8	SMSA 4-digit SMSA code (NA)
9-11	County/Municipio 000=Reservation total 1-999=3-digit county code
12-14	Indian Reservation/Trust Land 3-digit reservation code
15-15	Suppression flag for total population 0=data describing this population is not suppressed 1=data describing this population is suppressed

16-16	Suppression flag for non-Hispanic, white population 0=data describing this population is not suppressed 1=data describing this population is suppressed
17-17	Suppression flag for non-Hispanic, black population 0=data describing this population is not suppressed 1=data describing this population is suppressed
18-18	Suppression flag; for non-Hispanic, Native American population 0=data describing this population is not suppressed 1=data describing this population is suppressed
19-19	Suppression flag for non-Hispanic, Asian, Pacific population 0=data describing this population is not suppressed 1=data describing this population is suppressed
20-20	Suppression flag for Hispanic population 0=data describing this population is not suppressed 1=data describing this population is suppressed
21-24	Filler (space-filled)
25-60	Name of geographic unit

Table 1

	Poverty universe
	All races
61-68	Under 1 year old
69-76	1 year old
77-84	2 years old
85-92	3 years old
93-100	4 years old
101-108	5 years old
109-116	6-12 years old
117-124	13-18 years old
125-188	White, non-Hispanic
189-252	Black, non-Hispanic
253-316	Native American, non-Hispanic
317-380	Asian, Pacific, non-Hispanic
381-444	Hispanic
445-828	Below 100% of poverty level
829-1212	Below 130% of poverty level
1213-1596	Below 185% of poverty level

WOMEN, INFANTS, AND CHILDREN - INDIAN RESERVATIONS

Table 2

	Poverty universe
	All races
	Under 19 years old
1597-1604	Women with own children under 6 months
1605-1612	Women with own children under 12 months
1613-1620	All women
1621-1644	19-26 years old
1645-1668	27-35 years old
1669-1692	36 years and over
1693-1788	White, non-Hispanic
1789-1884	Black, non-Hispanic
1885-1980	Native American, non-Hispanic
1981-2076	Asian, Pacific, non-Hispanic
2077-2172	Hispanic
2173-2748	Below 100% of poverty level
2749-3324	Below 130% of poverty level
3325-3900	Below 185% of poverty level

Table 3

	Poverty universe
	All races
3901-3908	Under 19 years old
3909-3916	19-26 years old
3917-3924	27-35 years old
3925-3932	36 years and over
3933-3964	White, non-Hispanic
3965-3996	Black, non-Hispanic
3997-4028	Native American, non-Hispanic
4029-4060	Asian, Pacific, non-Hispanic
4061-4092	Hispanic
4093-4284	Below 100% of poverty level
4285-4476	Below 130% of poverty level
4477-4668	Below 185% of poverty level

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APPENDIX B

METHOD FOR ESTIMATING THE NUMBER OF PREGNANT WOMEN POTENTIALLY ELIGIBLE FOR THE WIC PROGRAM FROM THE 1980 CENSUS SPECIAL EXTRACT

One set of tables in the special Census tape contains the number of women in each cell (county, State, race, age, and poverty level) who reported having natural (own) children up to 9 months old on April 1, 1980. In the following paragraphs, this number is identified as N, and refers to the entry in each cell at each level of aggregation across cell descriptor categories. This is the count of all deliveries that resulted in live births for which a child survived until April 1, 1980, and which occurred in the period July 1, 1979, to March 31, 1980. This number (N) estimates the number of pregnancies that began with conceptions during the period October 1, 1978, to June 30, 1979. As such, it is an estimate of the number of women who were pregnant at all possible gestational ages at the end of this period. This estimate is unadjusted for time variance in the rate of conception, e.g., seasonality. However, with the assumption of approximate constancy in birth rates, it provides an estimate of the number of women who were pregnant, at all possible gestational ages, at any given point in time during the period. The number N is an underestimate of those pregnancies, however, because it omits pregnancies that resulted in live births but for which the infant died prior to April 1, 1980 or was absent for other reasons (e.g., adoption), and it omits pregnancies that terminated without a live birth.

The procedure for adjusting for infant deaths and pregnancy terminations is based on published Vital Statistics on infant mortality and fetal deaths. The proportion of infant deaths as a fraction of live births during the period July 1, 1979, to March 31, 1980, is denoted as PI. The proportion of fetal deaths occurring between February 20, 1979, and November 13, 1979, as a proportion of live births in the period July 1, 1979, to March 31, 1980, is denoted as PT. The adjustment for fetal deaths is not a complete adjustment for "pregnancy wastage" because PT includes only the rate of termination of pregnancy resulting in fetal deaths for pregnancies at 20 weeks gestation or later, since the National Center for Health Statistics (NCHS) Vital Statistics reports do not report pregnancy terminations prior to 20 weeks gestational age. This estimate of pregnancies omits, therefore, any adjustment for spontaneous or induced abortions occurring prior to 20 weeks gestation.

Similarly, the adjustment for the absence of infants from the mother's household is incomplete because Vital Statistics data document infant deaths but not other types of child absence. The adjustment procedure therefore undercounts because it omits sources of absence such as adoption. The incompleteness of adjustments possible with available data results in a slight undercount in the estimated number of women pregnant at a given point in time.

The adjustment procedure used applies a standard result for stationary Markov processes in steady state, i.e., a process such as the birth-death process in the U.S. population which is assumed to have stable parameters in the short run. For any reference period (t), the number of pregnancies (N) equals the

number of conceptions (C) minus the number of fetal and infant deaths (I). Markov theory then yields the following algebraic result:

$$N(t) = C(t - 1)[1 - PT - PI]$$

where (t) denotes a period of time, i.e., the 9 months from July 1, 1979, to March 31, 1980, and (t - 1) denotes the previous 9-month period, October 1, 1978, to June 30, 1979. The estimate of pregnancies based on the number of women with own children aged 0-to-9 months is then given by the equation:

$$C(t-1) = N(t) / [1 - PT - PI].$$

The number 1/ [1 - PT - PI] is the adjustment factor by which the Census extract data cell entries were multiplied to obtain the estimated number of pregnant women. The numbers derived from published Vital Statistics that were used for the adjustment factor for each State/Race combination are presented in table B-1. PI was computed from published statistics as:

$$PI = 0.98[2/3 \text{ the 1979 IMR} + 1/3 \text{ the 1980 IMR}] /1000,$$

because 98 percent of all infant deaths in the United States have occurred prior to 9 months of age and the relevant period for PI includes the last half of 1979 and the first quarter of 1980; i.e., 2/3 of the infant deaths occurred in 1979 and 1/3 occurred in 1980. Infant Mortality Rates (IMR) were available by race and State for 1979 but only at the national level for 1980. In

computing PI for table B-1, the decline in the 1980 IMR from 1979 was assumed to have occurred equiproportionately across States. PT was computed as:

PT = Fetal Death Rate for 1979 /1000.

The period of interest is February 20, 1979, to November 13, 1979.

No adjustments are made for maternal deaths because the rates are too low to affect the final estimates. The computed adjustment factor would add less than 1 pregnancy per 10,000 pregnancies on average, and at most 14 pregnancies per 100,000 pregnancies in a year.

No adjustment is made for premature births because overcounting of surviving premature births occurring after July 1, 1979, is offset by surviving premature births occurring prior to July 1, 1979, that would not be counted as a pregnancy because the child was older than 9 months on April 1, 1980.

Finally, Vital Statistics are generally reported for three racial categories: White, Black, and Other. In cases where they are not reported for Hispanics, Asians, and Native Americans, the following procedure was implemented. The Hispanics were assigned the rates for whites because the U.S. Natality and Mortality Vital Statistics include the births and deaths for Hispanics in the White category. The rates for other nonblacks were assigned to Asians and Native Americans. This rate was computed by subtracting the weighted proportion for the Black population from the rate for the total Other population and dividing by the complement of the weight for the Black population. These weights (the proportions of the total Other populations which are black) are given in table B-2.

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Table B-1. Adjustment Factors Used to Estimate the Number of Women Pregnant as of June 30, 1979

State	Race	Infant Mortality Rate for 9 Months*	Fetal Death Rate for 9 Months*	Population Adjustment Factor
United States	All	12.7	9.4	1.0226
	White	11.0	8.4	1.0194
	Black	21.2	14.6	1.0359
	Other	9.4	9.7	1.0191
	Hispanic	11.0	8.4	1.0194
Alabama	All	13.9	10.7	1.0253
	White	11.0	8.6	1.0196
	Black	19.4	15.3	1.0347
	Other	10.1	10.1	1.0202
	Hispanic	11.0	8.6	1.0196
Alaska	All	15.4	8.8	1.0248
	White	13.0	8.6	1.0216
	Black	16.5	9.8	1.0262
	Other	22.1	6.4	1.0285
	Hispanic	13.0	8.6	1.0216
Arizona	All	13.2	7.5	1.0211
	White	12.1	7.2	1.0193
	Black	23.9	9.6	1.0334
	Other	17.4	6.3	1.0237
	Hispanic	12.1	7.2	1.0193
Arkansas	All	13.0	9.9	1.0234
	White	11.0	7.6	1.0186
	Black	19.1	17.0	1.0361
	Other	9.6	11.2	1.0208
	Hispanic	11.0	7.6	1.0186
California	All	10.8	8.3	1.0195
	White	10.5	7.9	1.0184
	Black	17.4	10.9	1.0284
	Other	7.7	7.2	1.0149
	Hispanic	10.5	7.9	1.0184
Colorado	All	10.3	9.6	1.0203
	White	10.2	9.4	1.0196
	Black	15.5	12.8	1.0283
	Other	4.1	8.5	1.0126
	Hispanic	10.2	9.4	1.0196
Connecticut	All	11.7	8.4	1.0205
	White	10.6	7.9	1.0185
	Black	20.6	12.1	1.0327
	Other	10.3	8.0	1.0183
	Hispanic	10.6	7.9	1.0185

Table B-1 continued

State	Race	Infant Mortality Rate for 9 Months*	Fetal Death Rate for 9 Months*	Population Adjustment Factor
Delaware	All	16.4	9.2	1.0263
	White	12.7	6.8	1.0195
	Black	29.3	17.4	1.0467
	Other	15.3	11.5	1.0268
	Hispanic	12.7	6.8	1.0195
Dist. Columbia	All	21.5	14.8	1.0376
	White	5.3	9.7	1.0150
	Black	24.9	16.7	1.0416
	Other	0.0	11.0	1.0110
	Hispanic	5.3	9.7	1.0150
Florida	All	14.4	9.8	1.0248
	White	12.0	8.1	1.0201
	Black	21.8	15.2	1.0370
	Other	9.8	10.0	1.0198
	Hispanic	12.0	8.1	1.0201
Georgia	All	14.6	14.6	1.0301
	White	11.3	12.2	1.0235
	Black	20.8	19.8	1.0407
	Other	1.8	13.1	1.0149
	Hispanic	11.3	12.2	1.0235
Hawaii	All	9.7	10.5	1.0206
	White	9.8	14.2	1.0240
	Black	13.0	9.9	1.0228
	Other	9.6	6.5	1.0161
	Hispanic	9.8	14.2	1.0240
Idaho	All	9.7	6.9	1.0169
	White	9.7	7.0	1.0167
	Black	12.2	5.4	1.0176
	Other	7.8	3.6	1.0114
	Hispanic	9.7	7.0	1.0167
Illinois	All	14.7	9.4	1.0247
	White	11.7	8.1	1.0198
	Black	26.1	14.6	1.0407
	Other	8.7	9.7	1.0184
	Hispanic	11.7	8.1	1.0198
Indiana	All	12.6	9.0	1.0221
	White	11.6	8.2	1.0198
	Black	21.6	16.2	1.0379
	Other	7.7	10.7	1.0184
	Hispanic	11.6	8.2	1.0198
Iowa	All	10.3	6.9	1.0175
	White	10.0	6.9	1.0169
	Black	21.7	9.8	1.0315
	Other	10.5	6.4	1.0169
	Hispanic	10.0	6.9	1.0169

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Table B-1 continued

State	Race	Infant Mortality Rate for 9 Months*	Fetal Death Rate for 9 Months*	Population Adjustment Factor
Kansas	All	10.9	8.4	1.0197
	White	10.3	7.8	1.0181
	Black	18.7	14.9	1.0336
	Other	9.3	9.8	1.0191
	Hispanic	10.3	7.8	1.0181
Kentucky	All	11.1	9.3	1.0209
	White	10.4	8.6	1.0190
	Black	19.4	15.9	1.0353
	Other	1.8	10.5	1.0123
	Hispanic	10.4	8.6	1.0190
Louisiana	All	15.1	10.6	1.0264
	White	11.7	7.6	1.0193
	Black	20.6	16.0	1.0367
	Other	7.6	10.6	1.0182
	Hispanic	11.7	7.6	1.0193
Maine	All	9.4	7.3	1.0170
	White	9.4	7.2	1.0166
	Black	0.0	10.3	1.0103
	Other	8.4	6.8	1.0152
	Hispanic	9.4	7.2	1.0166
Maryland	All	14.0	9.4	1.0240
	White	11.2	7.4	1.0186
	Black	21.0	14.5	1.0356
	Other	5.2	9.6	1.0148
	Hispanic	11.2	7.4	1.0186
Massachusetts	All	10.5	6.0	1.0168
	White	10.2	6.1	1.0163
	Black	16.0	5.5	1.0215
	Other	7.5	3.6	1.0112
	Hispanic	10.2	6.1	1.0163
Michigan	All	12.9	7.5	1.0208
	White	11.1	6.7	1.0178
	Black	22.4	11.7	1.0341
	Other	6.0	7.7	1.0137
	Hispanic	11.1	6.7	1.0178
Minnesota	All	10.4	7.0	1.0178
	White	10.1	6.9	1.0170
	Black	22.8	8.8	1.0316
	Other	13.3	5.8	1.0191
	Hispanic	10.1	6.9	1.0170

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Table B-1 continued

State	Race	Infant Mortality Rate for 9 Months*	Fetal Death Rate for 9 Months*	Population Adjustment Factor
Mississippi	All	17.0	14.0	1.0320
	White	11.5	8.7	1.0202
	Black	23.0	20.7	1.0437
	Other	17.2	13.7	1.0308
	Hispanic	11.5	8.7	1.0202
Missouri	All	13.3	9.2	1.0230
	White	11.7	8.6	1.0203
	Black	22.6	13.4	1.0360
	Other	7.8	8.8	1.0167
	Hispanic	11.7	8.6	1.0203
Montana	All	10.4	8.3	1.0190
	White	10.3	8.0	1.0183
	Black	0.0	11.7	1.0117
	Other	12.2	7.7	1.0199
	Hispanic	10.3	8.0	1.0183
Nebraska	All	11.2	8.7	1.0203
	White	10.7	8.5	1.0192
	Black	22.6	11.8	1.0344
	Other	11.2	7.8	1.0190
	Hispanic	10.7	8.5	1.0192
Nevada	All	12.1	7.9	1.0204
	White	10.8	6.8	1.0176
	Black	23.0	15.3	1.0383
	Other	12.9	10.1	1.0230
	Hispanic	10.8	6.8	1.0176
New Hampshire	All	10.3	6.6	1.0171
	White	10.4	6.6	1.0170
	Black	10.7	5.4	1.0161
	Other	1.1	3.6	1.0046
	Hispanic	10.4	6.6	1.0170
New Jersey	All	12.5	8.9	1.0218
	White	10.2	7.4	1.0176
	Black	21.9	14.9	1.0368
	Other	11.4	9.8	1.0212
	Hispanic	10.2	7.4	1.0176
New Mexico	All	13.5	7.4	1.0214
	White	12.5	7.2	1.0197
	Black	16.5	8.8	1.0253
	Other	19.3	5.8	1.0251
	Hispanic	12.5	7.2	1.0197
New York	All	13.2	11.9	1.0257
	White	11.5	10.9	1.0224
	Black	20.2	16.1	1.0363
	Other	9.6	10.7	1.0203
	Hispanic	11.5	10.9	1.0224

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Table B-1 continued

State	Race	Infant Mortality Rate for 9 Months*	Fetal Death Rate for 9 Months*	Population Adjustment Factor
North Carolina	All	14.6	11.1	1.0264
	White	10.8	9.0	1.0198
	Black	23.6	16.3	1.0399
	Other	10.3	10.8	1.0211
	Hispanic	10.8	9.0	1.0198
North Dakota	All	11.5	9.5	1.0215
	White	10.8	9.5	1.0203
	Black	0.0	10.4	1.0104
	Other	21.6	6.9	1.0284
	Hispanic	10.8	9.5	1.0203
Ohio	All	12.4	9.1	1.0220
	White	11.2	8.2	1.0194
	Black	20.1	14.8	1.0348
	Other	7.9	9.7	1.0176
	Hispanic	11.2	8.2	1.0194
Oklahoma	All	12.1	9.3	1.0219
	White	11.4	8.8	1.0202
	Black	18.2	11.7	1.0299
	Other	11.2	7.7	1.0189
	Hispanic	11.4	8.8	1.0202
Oregon	All	10.5	7.3	1.0182
	White	10.5	7.1	1.0176
	Black	12.0	10.3	1.0223
	Other	11.0	6.8	1.0178
	Hispanic	10.5	7.1	1.0176
Pennsylvania	All	12.9	11.2	1.0247
	White	11.6	10.2	1.0218
	Black	21.9	18.9	1.0408
	Other	6.3	12.5	1.0188
	Hispanic	11.6	10.2	1.0218
Rhode Island	All	13.6	11.5	1.0258
	White	12.1	11.4	1.0235
	Black	34.2	13.8	1.0480
	Other	22.4	9.1	1.0315
	Hispanic	12.1	11.4	1.0235
South Carolina	All	16.5	12.6	1.0300
	White	12.0	9.3	1.0213
	Black	23.6	18.4	1.0419
	Other	5.6	12.1	1.0177
	Hispanic	12.0	9.3	1.0213

Table B-1 continued

State	Race	Infant Mortality Rate for 9 Months*	Fetal Death Rate for 9 Months*	Population Adjustment Factor
South Dakota	All	10.8	8.6	1.0198
	White	9.3	7.4	1.0167
	Black	29.5	17.3	1.0468
	Other	20.4	11.4	1.0318
	Hispanic	9.3	7.4	1.0167
Tennessee	All	13.2	9.9	1.0236
	White	11.1	8.9	1.0200
	Black	20.4	14.0	1.0344
	Other	5.5	9.2	1.0147
	Hispanic	11.1	8.9	1.0200
Texas	All	12.5	8.6	1.0215
	White	11.1	8.1	1.0192
	Black	20.7	11.7	1.0324
	Other	9.9	7.7	1.0177
	Hispanic	11.1	8.1	1.0192
Utah	All	10.4	7.7	1.0184
	White	10.4	7.8	1.0182
	Black	16.9	6.6	1.0235
	Other	6.4	4.3	1.0108
	Hispanic	10.4	7.8	1.0182
Vermont	All	8.2	6.3	1.0147
	White	8.3	6.3	1.0146
	Black	0.0	0.0	1.0000
	Other	0.0	0.0	1.0000
	Hispanic	8.3	6.3	1.0146
Virginia	All	14.1	13.9	1.0288
	White	12.1	12.0	1.0241
	Black	20.7	20.4	1.0411
	Other	6.0	13.5	1.0194
	Hispanic	12.1	12.0	1.0241
Washington	All	11.1	7.1	1.0186
	White	11.2	6.9	1.0181
	Black	12.2	9.3	1.0215
	Other	9.0	6.2	1.0152
	Hispanic	11.2	6.9	1.0181
West Virginia	All	13.4	10.5	1.0244
	White	13.0	10.4	1.0234
	Black	23.1	13.3	1.0363
	Other	15.0	8.8	1.0237
	Hispanic	13.0	10.4	1.0234

Table B-1 continued

State	Race	Infant Mortality Rate for 9 Months*	Fetal Death Rate for 9 Months*	Population Adjustment Factor
Wisconsin	All	10.4	7.0	1.0178
	White	10.0	6.8	1.0168
	Black	18.3	9.1	1.0274
	Other	7.0	6.0	1.0131
	Hispanic	10.0	6.8	1.0168
Wyoming	All	12.8	7.0	1.0202
	White	12.8	7.1	1.0199
	Black	27.1	4.5	1.0315
	Other	8.8	2.9	1.0117
	Hispanic	12.8	7.1	1.0199

* Specified as a rate per 1000 live births.

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Table B-2. Number of Females by Ethnic Category in the United States on April 1, 1980

State	Total	White	Black	Hispanic	Weight of Black*
UNITED STATES	99,369,331	78,047,312	12,106,462	6,803,752	0.834
ALABAMA	1,779,651	1,281,358	472,850	15,249	0.979
ALASKA	166,314	124,279	5,185	3,745	0.135
ARIZONA	1,189,368	866,457	30,634	209,062	0.269
ARKANSAS	1,025,358	833,527	174,399	7,908	0.948
CALIFORNIA	10,023,599	6,474,684	782,302	2,089,196	0.536
COLORADO	1,212,877	989,943	41,249	157,593	0.631
CONNECTICUT	1,372,015	1,200,299	98,438	60,584	0.886
DELAWARE	263,310	211,355	44,474	4,490	0.937
DISTRICT OF COLUMBIA	247,672	41,128	197,102	6,402	0.985
FLORIDA	4,265,062	3,199,802	618,607	403,563	0.935
GEORGIA	2,465,762	1,733,667	687,185	26,885	0.974
HAWAII	417,678	118,587	4,928	31,946	0.018
IDAHO	414,270	390,034	850	15,485	0.097
ILLINOIS	5,022,574	3,864,253	782,320	287,876	0.899
INDIANA	2,426,981	2,179,347	191,684	39,959	0.923
IOWA	1,246,899	1,207,502	17,896	11,910	0.651
KANSAS	1,008,727	911,030	53,922	27,708	0.770
KENTUCKY	1,638,462	1,504,866	114,009	11,454	0.933
LOUISIANA	1,906,840	1,258,550	585,647	44,572	0.970
MAINE	487,923	481,085	1,126	2,329	0.250
MARYLAND	1,880,504	1,369,008	443,822	28,979	0.920
MASSACHUSETTS	2,468,119	2,274,877	93,268	66,080	0.733
MICHIGAN	4,108,251	3,432,400	553,149	72,326	0.917
MINNESOTA	1,726,102	1,657,813	21,191	14,157	0.391
MISSISSIPPI	1,151,113	712,933	419,963	10,939	0.983
MISSOURI	2,150,645	1,873,160	236,266	22,645	0.927
MONTANA	334,867	310,642	508	4,494	0.026
NEBRASKA	668,879	626,638	21,510	12,583	0.725
NEVADA	335,735	276,482	22,401	23,615	0.629
NEW HAMPSHIRE	397,331	391,397	1,534	2,142	0.405
NEW JERSEY	3,345,530	2,620,534	427,016	239,041	0.879
NEW MEXICO	584,253	295,083	9,098	224,149	0.140
NEW YORK	7,706,826	5,664,795	1,068,765	799,545	0.860
NORTH CAROLINA	2,633,397	1,952,277	613,837	23,650	0.934
NORTH DAKOTA	272,545	259,597	772	1,492	0.067
OHIO	4,800,251	4,221,150	490,902	54,449	0.936
OKLAHOMA	1,317,002	1,116,104	89,860	25,364	0.512
OREGON	1,111,423	1,037,432	14,981	27,712	0.324
PENNSYLVANIA	5,261,724	4,675,471	477,295	70,167	0.925
RHODE ISLAND	413,000	386,379	11,797	8,437	0.649

Table B-2 continued

State	Total	White	Black	Hispanic	Weight of Black*
SOUTH CAROLINA	1,414,696	938,957	450,697	15,037	0.978
SOUTH DAKOTA	292,647	267,944	616	1,692	0.027
TENNESSEE	2,070,644	1,705,001	338,707	15,452	0.967
TEXAS	6,293,599	4,013,726	773,284	1,420,863	0.900
UTAH	652,421	604,752	3,249	26,569	0.154
VERMONT	214,922	211,978	345	1,369	0.219
VIRGINIA	2,348,231	1,811,926	460,973	35,606	0.921
WASHINGTON	1,735,192	1,561,980	41,194	52,477	0.341
WEST VIRGINIA	875,281	837,337	28,240	5,794	0.878
WISCONSIN	2,023,142	1,885,007	85,246	28,087	0.775

* percent of the total other(nonwhite) population that is black

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APPENDIX C

METHOD FOR ESTIMATING THE NUMBERS OF POSTPARTUM AND BREASTFEEDING WOMEN POTENTIALLY ELIGIBLE FOR THE WIC PROGRAM FROM THE 1980 CENSUS SPECIAL EXTRACT

The Census special extract includes counts of women up to 6 months postpartum and up to 12 months postpartum. The WIC categories for program eligibility are 0-6 months postpartum if not breastfeeding (Postpartum category) and 0-12 months postpartum if breastfeeding (Breastfeeding category). (The designations 0-6, 0-12, and 6-12 are used consistently to mean up to, rather than through, the sixth month or twelfth month following birth.) To estimate the number of women in each WIC eligibility category from the Census data, it is necessary first to estimate the frequency of breastfeeding among women in each of the postpartum subperiods, 0-6 months and 6-12 months. The estimated number of breastfeeding women, 0-6 months postpartum, are then subtracted from all 0-6-month-postpartum women to obtain the estimated number of WIC Postpartum women (nonbreastfeeding), and the estimated numbers of breastfeeding women in the 0-6-month-postpartum and 6-12-month-postpartum subperiods are summed to obtain the estimated number of WIC Breasfeeding women.

The estimated frequencies of breastfeeding among women in the two postpartum subperiods were derived from data from the Mother's Questionnaire of the 1980 National Natality Survey (NNS) of the National Center for Health Statistics, Department of Health and Human Services.

duration may be viewed as distinct phenomena, subject to similar but not necessarily identical determinants. Therefore, a two-stage estimation process was applied. In the first step, a predictive model was used to estimate the probability that a woman will initiate breastfeeding, estimated as a function of available socioeconomic and demographic information from the NNS survey data. In the second step, a second predictive model was used to estimate the probability that a woman will breastfeed for at least 6 months as a function of the variables that describe the cell entries in the Census extract data. The second step is estimated as a conditional probability which is "conditioned" on the probability of the initiation of breastfeeding. The results of the second step are used to compute a table of predicted prevalences of breastfeeding beyond 6 months as a function of the significant variables from the second-step estimation and the sample weights in the survey data. This table is then used as the multipliers for the cells in the special Census extract for postpartum women with own children 6-12-months old.

A similar table of predicted prevalences of breastfeeding in the 0-6-month period was computed, based on the estimated probability of initiating breastfeeding as a function of the descriptor variables for the cell entries in the Census extract data. This table provided the multipliers for the cells in the special census extract for postpartum women with own children 0-6-months old.[1]

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[1] This procedure tends to overestimate the number of WIC-eligible breastfeeding women, both in the period up to 6-months postpartum, since it does not provide for netting out those women who terminate breastfeeding earlier than 6 months following delivery, and in the period 6-12-months postpartum, since it does not net out those women who breastfeed longer than six months but fewer than twelve.

The 2-step statistical procedure described serves to "smooth" or interpolate the survey data on breastfeeding into the level of detail required for applying to the cells of the Census extract data. The number of observations available in the survey data would not permit direct estimation of breastfeeding frequencies at this level of detail. The 2-step process, however, permits utilization of the available survey data, based on statistical associations between breastfeeding behaviors and then socioeconomic and demographic predicators.

Formally, the procedure may be described as followed, where each step is estimated by logistic regression:

Step 1

Prob (Initiating Breastfeeding) =

L (Socioeconomic and demographic predictor variables)

Step 2

Prob (Breastfeeding >6 months) =

L (Census tape predictor variables and the predicted probability of initiating breastfeeding as obtained from step 1)

Tables C-1 through C-3 present the weighted frequencies of three breastfeeding characteristics (never breastfed, breastfed less than 6 months, and breast-fed more than 6 months) by race, age, and income variables from the NNS data. Table C-4 presents the logistic regression results for step 1; race, mothers' education, parity, working hours of the mothers, and the fathers' education are significant predictors of the decision to initiate breastfeeding. Household income and mothers' age are not significant predictors. Mothers

with high parity and who are identified racially as black have lower probabilities of initiating breastfeeding. All other significant predictors are positively associated with the decision to initiate breastfeeding. The predicted probabilities from this model are then used as predictor variables in step 2.

The results of step 2 are presented in table C-5. In this statistical model, the predictor variables that describe the cells of the Census tape are coded as zero or one, with one indicating that the mothers' data record would be classified in the indicated category. For statistical reasons (i.e., estimability) one or more categories are omitted for each class of variables. Thus, the estimated effects are comparisons of the effects (or category) included in the model versus the average of the omitted categories. For example, in the Race effect, black mothers are contrasted against the breastfeeding behavior of all other mothers in the data. The White, Hispanic and Other categories were combined due to the paucity of data for the Others category, and because the average of Hispanic and Others showed no statistically significant difference from the White category of mothers regarding breastfeeding behavior. By contrast, the observed prevalence of breastfeeding more than 6 months by black women is one-third the prevalence for all other racial categories.

The poverty categories are compared against the category of women whose household income would have classified them above 185 percent of the poverty

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Table C-1. Frequency of Breastfeeding by Race of Mother, National Natality Survey (n=7484))

Racial Group	Never Breast-fed	Breast-fed Less Than 6 Months	Breast-fed 6 Months or More
All Groups	42.4	38.3	19.2
White	40.6	38.8	20.5
Black	60.7	31.9	7.3
Other	34.6	41.4	24.0
Hispanic	45.7	38.3	15.9

Table C-2. Frequency of Breastfeeding by Age of Mother, National Natality Survey (n=7484)

Age in Years	Never Breast-fed	Breast-fed Less Than 6 months	Breast-fed 6 Months or More
All	42.4	38.3	19.2
<=18	49.3	33.7	7.0
19-26	43.9	39.8	16.3
27-35	37.7	37.5	24.8
36 and above	46.6	32.1	21.3

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Table C-3. Frequency of Breastfeeding by Annual Household Income, National Natality Survey
(n=7484)

Annual Income	Never Breast-fed	Breast-fed Less Than 6 Months	Breast-fed 6 Months or More
$3,000 or less	57.5	33.9	8.6
$3,001-6,000	56.1	33.8	10.1
$6,001-9,000	48.9	35.3	15.8
$9,001-12,000	47.2	39.5	13.3
$12,001-15,000	42.7	36.5	20.8
$15,001-18,000	43.2	39.0	17.8
$18,001-21,000	39.9	38.6	21.4
$21,001-24,000	43.9	38.7	17.3
$24,001-27,000	39.2	39.5	21.3
$27,001-30,000	39.6	36.5	23.8
$30,001 and above	31.9	41.8	26.3

Table C-4. Logistic Regression of the Incidence of Initiating Breastfeeding; Dependent Variable: Ever Breast-fed

Independent Variables	Beta	Chi-Square
Intercept	-2.837	255.78**
Income	0.000	0.11
Mother's Age	0.002	0.15
Black	-0.729	67.04**
Mother's Education	0.149	111.75**
Parity	-0.080	10.45**
Hours Working	0.003	3.75**
Father's Education	0.094	61.61**

**Significant at .05 level or lower.

Fraction of concordant pairs of predicted probabilities and responses: 0.661.

Rank correlation between predicted probability and response: 0.343.

Table C-5. Logistic Regression of Breastfeeding More Than 6 Months; Dependent Variable: Breast-fed More Than 6 Months

Independent Variables	Beta	Chi-Square
Intercept	-3.416	231.18**
Predicted Probability of Initiating Breastfeeding	3.738	187.82**
Below 100% of Poverty	-0.158	1.30
100-130% of Poverty	0.259	4.20**
130-185% of Poverty	0.192	4.39**
Black	-0.557	10.14**
Mother's Age <18	-1.010	12.96**
Mother's Age 19-26	-0.304	3.57*
Mother's Age 27-35	-0.010	0.00

*Significant at .10 level.

**Significant at .05 level or lower.

Fraction of concordant pairs of predicted probabilities and responses: 0.658.

Rank correlation between predicted probability and response: 0.349.

criterion. The results indicate that women below the poverty line are statistically not significantly different from women above 185 percent of poverty, while women in the two middle categories exhibit significantly higher probabilities of continuing breastfeeding beyond 6 months than either of the extreme groups.

Generally, the predictive model for step 2 indicates that nonblack women whose income classifies them between 100 percent and 185 percent of poverty and who are more than 26 years old are more likely to breastfeed beyond 6 months than are mothers in other categories.

The predicted probabilities from step 2 were then weighted to produce the point estimates of prevalence in table C-6. These estimates were used to multiply the Census population numbers of women in the 6-12-month-postpartum period to obtain the estimated numbers of women who were likely to be breastfeeding more than 6 months, by the age, race, and income categories in the Census data extract. The model also was used to tabulate upper and lower confidence limits for each point estimate of the prevalence of continuing breastfeeding beyond 6 months. For example, the 95 percent confidence interval for the lowest predicted point estimate (2.1 percent) for young black women between 100 and 130 percent of poverty is 1.2 to 3.7 percent. For the highest predicted prevalence (27.7 percent) for women between 130 and 185 percent of poverty in the Other ethnic/racial category and aged 27 to 35 years. The 95-percent confidence interval is 24.2 to 31.5 percent. Table C-7 shows the comparable point estimates, by woman's age, race, and poverty status, for the probability of initiating breastfeeding.

Tests of alternative specifications of the logistic models, including tests for interactions on race, age, and poverty categories proved nonsignificant. Alternative modelling approaches, e.g., Tobit estimation of duration, produced substantially poorer fits of the data.

Table C-6. Estimated Probability of Breastfeeding More Than 6 Months, by Poverty Status, Race, and Age of Mother

Percent of Poverty, By Race		Age of Mother			
		<18	19-26	27-35	36+
<100%	White	0.0450	0.1091	0.1535	0.1083
	Black	0.0217	0.0363	0.0506	0.0346
	Other	0.0433	0.1472	0.0908	0.2088
	Hispanic	0.0418	0.0983	0.1109	0.0796
100-129%	White	0.0756	0.1743	0.2386	0.1923
	Black	0.0211	0.0613	0.0657	0.0528
	Other	0.0830	0.1615	0.1642	0.2392
	Hispanic	0.0642	0.1512	0.1778	0.1045
130-184%	White	0.0741	0.1691	0.2255	0.1883
	Black	0.0254	0.0577	0.0657	0.1579
	Other	0.0295	0.1733	0.2775	0.1369
	Hispanic	0.0613	0.1473	0.1943	0.2020
185%+	White	0.0598	0.1674	0.2591	0.2371
	Black	0.0207	0.0623	0.0860	0.0856
	Other	0.0207	0.1875	0.2906	0.2671
	Hispanic	0.0590	0.1600	0.2348	0.1377

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Table C-7. Estimated Probability of Initiating Breastfeeding, by Poverty Status, Race, and Maternal Age

Percent of Poverty, By Race		Maternal Age (Years)			
		<18	19-26	27-35	36+
<100%	White		0.4585	0.4756	0.3615
	Black	0.3024	0.2972	0.3062	0.2037
	Other	0.3957	0.5339	0.3136	0.5929
	Hispanic	0.3648	0.4017	0.3600	0.2591
100-129%	White	0.4395	0.4989	0.5215	0.4531
	Black	0.2367	0.3360	0.2748	0.1941
	Other	0.4723	0.4687	0.3918	0.5232
	Hispanic	0.3829	0.4403	0.4104	0.2405
130-184%	White	0.4504	0.5059	0.5216	0.4478
	Black	0.3028	0.3284	0.2915	0.5636
	Other	0.1979	0.5040	0.5913	0.3699
	Hispanic	0.3845	0.4479	0.4515	0.4174
185%+	White	0.4361	0.5537	0.6216	0.5806
	Black	0.2944	0.3932	0.4032	0.4044
	Other	0.2966	0.5827	0.6581	0.6166
	Hispanic	0.4226	0.5336	0.5806	0.3988

APPENDIX D

THE MODAL SETS OF STATE WIC AGENCY NUTRITIONAL RISK CRITERIA

To be eligible for the WIC Program, a person must be categorically eligible for participation as a pregnant, breastfeeding, or nonbreastfeeding postpartum woman, infant, or child under the age of 5; must meet the income eligibility standards of the program; and must be determined to be at nutritional risk by a competent professional authority.

Section 17(b)(8) of the Child Nutrition Act of 1966, as amended, defines nutritional risk as follows:

> 'Nutritional risk' means (A) detrimental or abnormal nutritional conditions detectable by biochemical or anthropometric measurements, (B) other documented nutritionally related medical conditions, (C) dietary deficiencies that impair or endanger health, or (D) conditions that predispose persons to inadequate nutritional patterns or nutritionally related medical conditions, including, but not limited to, alcoholism and drug addiction.

Current program regulations (7 CRF, Part 246) adopt the statutory language, giving State WIC agencies the authority to define the detailed operational criteria for nutritional risk in the WIC Program, within the statutory definition. Program regulations require WIC State agencies to include a description of the methods used to determine nutritional risk in their annual State Plan of Operation. The legislative definition requires that the determination of nutritional risk be based on medical or nutritional conditions that are measurable by specific indicators.

WIC Program regulations also establish a participant priority system designed to rank eligible WIC applicants on the basis of nutritional need for WIC benefits. The priority system is implemented by each local WIC agency when its caseload limit is reached. Local agency personnel then assign applicants to nutritional risk priority levels based upon their assessment of each person's nutritional status. Priorities I-III are reserved for WIC applicants determined to be at greater nutritional risk, based on nutritionally related medical risk conditions, and for infants based on their mother's risk status during pregnancy. Priorities IV-VI are used for WIC applicants determined to be at lesser nutritional risk, based on inappropriate or inadequate dietary intake, and for nonbreastfeeding postpartum women at nutritional risk under either medically or diet-based risk criteria. (Although, at State option, postpartum women also can be placed in Priority Level III.)

For the purpose of the WIC Eligibility Study, in order to estimate the prevalence of nutritional risk on a consistent and comparable basis across all States and local areas, it was necessary to construct a representative set of the nutritional risk criteria defined by the States for each WIC population group. A well-defined statistical measure was selected for identifying a representative set of the operational risk criteria employed in the WIC Program, appropriate for the objective of the eligibility study. That is, a measure was needed which would define that set of risk criteria that validly represents the most typical, prevalent, or frequently specified criteria for nutritional risk as defined throughout the WIC Program, by the States, for determining individual applicants' risk status and, hence, program eligibility.

The statistical measure chosen was the weighted modal set of risk-criterion values for those risk factors which (1) are unambiguously quantifiable from the operational State plans, and (2) were included in 50 percent or more of the 51 geographic State Agencies' 1984 Plans of Operation. The weighting was by the income-eligible population within the WIC categorical groups in each State and District of Columbia, as previously determined from the 1980 U.S. Census special data extract. The purpose of the weighting was to reflect the most frequent or prevalent WIC Program nutritional-risk criterion values in terms of the number of persons potentially affected by them rather than simply by the number of States employing them. (In practice, the weighting had only a slight effect.)

To determine the modal set of risk criteria, the 1984 operational plans of the 51 geographic State WIC agencies, including the District of Columbia, and 13 of the larger Indian WIC State agencies were examined and the detailed risk specifications presented were extracted. Comparison of the risk criteria used by the sample of Indian WIC State agencies and the 51 geographic State agencies showed close overall similarity. For this reason, and because the WIC-eligible populations of the Indian State agencies were not estimated separately from the 1980 Census data, but are included in the county and State geographic totals, the modal risk criterion values were derived solely from the 51 geographic State agency plans.[1]

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[1] Because of the small relative size of the Indian WIC State Agency Programs, their inclusion would have had no perceptible effect on the national weighted-modal risk criterion values for the WIC Program as a whole. As of 1986, the 36 Indian State agencies accounted in total for approximately 1.2 percent of all WIC participants in the 50 States and District of Columbia (FNS administrative data).

For most risk factors, the modal value of the criterion or cutoff value specified in the State plans was easily determined. A modal value is the value used by the greatest number of States. For example, it is a majority practice for State agencies to use high age of pregnant women as a high-risk (i.e., medically based) criterion. Of the 46 States that use high age as a criterion, 29 State agencies consider a pregnant woman to be at risk if she is over 35 years of age, while 13 States consider a woman over 34 years of age to be at high risk. Other State agencies did not use this criterion as reflective of high risk or used various other age brackets ranging from 33 to 36 years. Thus, the modal value among the States for this majority practice is over 35 years of age.

For some important risk factors, however, judgement was required in defining the modal criterion value. For example, States take two alternative approaches to identifying anemia in pregnant women. The majority practice is to apply single criterion values for hemoglobin and hematocrit to women in all stages of pregnancy. Within this majority practice, the modal value is easily determined, and was used as such in the WIC Eligibility Study. However, many States employ two or more different criterion values for hemoglobin and hematocrit in the different trimesters of pregnancy. Thus, for all States together, the modes are ambiguous on these important risk criteria. An alternative definition of the modes for hemoglobin and hematocrit was tested subsequently that could be defined across all 51 geographic State agencies. In this alternative approach, the hemoglobin and hematocrit values used by all States for the second trimester were considered together, which also yields a clearly defined mode. The modal values for both hemoglobin and hematocrit

resulting from this latter approach were identical to those observed among the majority group of States using single-valued criteria.

The general approach of determining modal values only for those risk criteria used by at least half the States in part was determined by practical considerations, but it also reflects the judgment that particular risk factors employed by less than a majority of States do not adequately represent the predominant or most representative practice in defining nutritional risk within the WIC Program. This approach omits a number of the particular risk factors that are included in many of the State plans.[2]

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[2] Examples of risk factors appearing in a minority of State plans and excluded from the modal set include the following (FNS administrative data):

Risk Factor	Percent of State Plans
PREGNANT WOMEN:	
Short stature	3
History of high-birth-weight infant	18
Intestinal parasites	18
Recent surgery	22
History of caesarean delivery	24
Lead poisoning	30
Dental problems	31
Food allergies	31
INFANTS:	
Post-mature birth	15
High birth weight	26
Intestinal parasites	33
Dental problems	33
Mentally retarded	35
Lead poisoning	41
Blood disorders	44
CHILDREN:	
Blood transfusion	13
Recent burns	20
Recent surgery	24
Mentally retarded	35
Allergies	41
Dental problems	44
Intestinal parasites	44
Lead poisoning	48

Another limitation on the modal set of risk criteria is that several of the risk factors that are widely included in State plans usually are grouped into broad general categories, difficult to quantify as such (e.g., "chronic medical conditions," "frequent infections," and "classical clinical signs of malnutrition"). In these cases, the grouped risk factors were included in the modal set of risk criteria if close counterpart or proxy variables could be defined in the available survey data (e.g., "chronic conditions"). These determinations were made by a medical doctor experienced in nutritional risk assessment.

In practice, not all the risk criteria included in the modal set of risk factors and criterion values were represented in the available data, or could be quantified in terms comparable to the WIC operational definitions (e.g., mental retardation, drug abuse, child of alcoholic/retarded/drug-addicted mother, inadequate longitudinal growth patterns). Proxy measures in the available data were utilized where possible, or several variables in the data were combined to form a nutritional risk indicator comparable to the WIC risk criterion definition.

Tables D-1 and D-2 show the risk factors and criterion values included in the modal set developed for the WIC Eligibility Study and used in developing binary risk indicator variables from the NHANES-II and National Natality Survey (NNS) data. These risk indicator variables then are used in the estimation of the frequency or prevalence of nutritional risk for each WIC population group, from the survey data, under the modal set of WIC risk criterion values.

The definition of the binary risk indicator variables is straightforward in principle. For each person in the data, and each available risk factor from the WIC modal set, a new risk datum is created through mapping the modal criterion values onto the survey information. When the survey data indicate the presence of a risk condition under the specified criterion value, the indicator variable is coded 1; when they show the absence of such risk condition under the criterion, it is coded zero.

Developing the risk indicators from the survey data was straightforward for most of the risk factors analyzed. However, more complex procedures were required for some of the important risk factors. This occurred when variable definitions or dimensionality in the survey data did not match exactly the operational definition or dimensionality of the same risk factor as observed in clinic settings and specified in the WIC State plans. The operational definitions of the risk indicators as developed from the survey data are described below.

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Table D-1

WIC Program Modal Nutritional Risk Criteria for Pregnant Women, 50 States and District of Columbia, 1984

Risk Criterion	Percent of States Using	Modal Cutoff Value	Reference Data
Anemia:			
Hemoglobin (g/100ml)	98.0	<11.0[c]	NHANES, NNS
Hematocrit (%)	100.0	≤33.0[c]	NHANES, NNS
Underweight (pregravid wt/ht)	94.8	<90%	NHANES
Overweight (pregravid wt/ht)	88.3	>120%	NHANES
Weight Loss During Pregnancy	63.8	>2 lbs/mo.	NHANES
Low Weight Gain During Pregnancy	82.1	<2 lbs/mo.	NNS
Twin or Multiple Gestation	58.0		NNS
Medical Conditions:			
Toxemia, Preeclampsia	80.7		NNS
Hypertension	88.1		NHANES, NNS
Diabetes, Renal Disorders	91.0		NHANES, NNS
Chronic Conditions	50.7		NHANES, NNS
Mental Retardation	50.2		
Low Age at Conception	97.3	<18 years	NHANES, NNS
High Age at Conception	85.0	>35 years	NHANES, NNS
History of High-Risk Pregnancies:			
Low Birth Weight Infant	92.3	<2500 g	NNS
Premature Infant	79.5	<37 weeks	NNS
Stillbirth	78.9	1 or more	NNS
Miscarriage	74.9	1 or more	NHANES, NNS
Multiple Births	53.7	1 or more	NNS
High Parity	69.8	5 or more	NHANES, NNS
Closely Spaced Pregnancies	89.3	<16 months	NNS
Alcohol Abuse	84.6	≥2 oz/day	NHANES, NNS
Drug Abuse	83.5		
Tobacco Abuse	63.5	≥20 cig/ day	NHANES
Inappropriate Dietary Pattern	100.0	*	NHANES

*Inadequate average servings per day from the basic four food groups. See p. D-28, ff.

Table D-2

WIC Program Modal Nutritional Risk Criteria for Infants and Children, 50 States and District of Columbia, 1984

Risk Criterion	Percent of States Using for Infants	Percent of States Using for Children	Modal Cutoff Value	Reference Data
Anemia:				
Hemoglobin (g/100 ml)	96.6	93.3	<11.0	NHANES
Hematocrit (%)	98.6	97.3	<34.0	NHANES
Low Birth Weight	90.0	--	2500g	NNS
Premature Birth	56.0	--	<37 weeks	NNS
Abnormal Growth Patterns:				
Obesity (percentile wt/ht)	83.4	77.5	>90th	NHANES
Underweight (percentile wt/ht)	97.3	93.0	<10th	NHANES
Short (percentile ht/age)	93.6	89.6	<5th	NHANES
Failure to Thrive	73.6	60.0		NHANES
Metabolic Disorders	64.3	65.4		NHANES
Nutrition-related Medical Conditions:				
Congenital Malformations	79.2	73.8		NHANES, NNS
Frequent Respiratory or Intestinal Problems	66.0	59.8	>3/year	NHANES
Cardiac Problems	67.4	(0.2)		NHANES

Table D-2 (Continued)

Risk Criterion	Percent of States Using for Infants	Percent of States Using for Children	Modal Cutoff Value	Reference Data
Child of Diagnosed Alcoholic Mother	58.5	(13.8)		NNS
Child of Diagnosed Drug-addicted Mother	58.5	(13.8)		
Infant Born to Mother in WIC	98.0	--		NNS**
Infant Born to High-Risk Mother, not in WIC	92.7	--		NNS**
Inappropriate Dietary Pattern	100.0	100.0	*	NHANES

*Inadequate average servings per day from the basic four food groups. See p. D-28, ff.

**Infants in the NNS data can be linked to mothers who were medically at risk during pregnancy under WIC-Program criteria, but the WIC participation of the mother is not known. Thus, the NNS data correspond to the combined WIC eligibility criteria for Priority-II infants (Mother participated in WIC during pregnancy, or Mother did not participate in WIC but was eligible on medically based risk criteria). This gives a slight undercount of eligible infants, since it omits those born to mothers who did participate in WIC but were not certified at risk on medically based criteria (Priority IV, diet-based risk only).

Definition of Medical Risk Indicators from National Survey Data

NHANES-II

The National Health and Nutrition Examination Survey (NHANES) program conducted by the National Center for Health Statistics (NCHS) is an expansion of the Health Examination Survey which was begun 20 years ago to collect data by direct standardized examinations of a sample of the population. In 1971, responsibility for monitoring the nutritional status of the population was added and the Health Examination Survey became the NHANES. NHANES-I, conducted from 1971 to 1975, was designed to assess overall health status with particular emphasis on dental health, skin problems, eye conditions, and the nutritional status of the population. For NHANES-II, mobile examination centers traveled to 64 locations across the country from 1976 to 1980 and examined approximately 28,000 people aged from 6 months to 74 years. The areas and subjects for the survey were chosen so that certain population groups believed to be at high risk of malnutrition (persons with low incomes, preschool children, women of childbearing age, and the elderly) were oversampled.

Two characteristics of the NHANES program pose significant limitations for the WIC Eligibility Study:

- The sample was a geographically based probability sample (clustered) of housing units which sampled selected persons within households, but not all persons in each household were surveyed. Based on this sampling scheme, the identification of mothers and their children, to identify characteristics which would admit one or the other into the WIC Program based on the risk status of the other, is not possible. In a similar manner, questions related to pregnancy history which are

linked with the children, for example, low birth weight, is asked in the mother's questionnaire but cannot be linked to a child.

- The NHANES did not survey infants under 6 months of age; therefore, health data are not available for infants 0-6 months of age to assess nutritional risk.

NNS

The 1980 National Natality Survey (NNS) and Fetal Mortality Survey were conducted by the National Center for Health Statistics. The 1980 NNS is a follow-back survey based on 9,941 certificates of live birth from a sample of births which occurred in the United States during the 12 months of 1980. Approximately 1 in 400 live births weighing less than 2500 grams were selected for inclusion in the follow-back survey. The birth certificate represents the basic source of information for all deliveries. The names and addresses of the mothers were taken from the birth certificates, and questionnaires were mailed to women who were married at the time of their delivery. These women were asked to provide additional information on prenatal health practices, prenatal care, previous pregnancies, and on social and demographic characteristics of themselves and their husbands. Each mother was also asked to sign a consent statement allowing the National Center for Health Statistics to obtain supplemental information from her medical records.

In addition, questionnaires were mailed to the hospitals and to the attendants at delivery named on the birth certificates, regardless of the mother's marital status. Questionnaires were sent to hospitals for all births which occurred in a hospital. Hospital questionnaires focused on the characteristics of labor and delivery, health characteristics of the mother and infant, information on prenatal care visits, and detailed information on

x-ray, ultrasound, nuclear medicine, and other radiation examinations and treatments received by the mother during the 12 months preceding her 1980 delivery. Questionnaires were also mailed to attendants at delivery (physicians, nurse-midwives, etc.) for those cases where the attendant was apparently not on the staff of the hospital. The questionnaires sent to attendants also sought information on prenatal care visits and detailed information on radiation examinations and treatments during the 12 months prior to delivery. A special questionnaire concerning the mother's exposure to ionizing radiation was sent to these medical sources.

While the 1980 NNS incorporates selected aspects of earlier natality follow-back surveys, it is unique in several respects:

- The number of cases included is greater than in previous natal surveys.
- Low-birth-weight infants (those under 2500 grams) were systematically oversampled to facilitate analyses which focus on these high-risk

- Extensive information was collected for the first time on births to unmarried women (although these women themselves were not contacted, information from the birth certificate was available and information from hospitals, attendants at delivery, and providers of radiation examinations and treatments was obtained).
- It is the first natality survey that collected certain information, such as: maternal alcohol consumption, occupation and industry of both parents, hematocrit and hemoglobin values during pregnancy, blood

pressure readings, tests for urine protein, amniocentesis and ultrasound.

- Consent statements were sought from women as a means of increasing the willingness of medical sources to provide information.

The 1980 NNS thus represents a comprehensive source of information concerning specific maternal and child health conditions and obstetric practices for live births occurring in the United States.

The 1980 National Fetal Mortality Survey (NFMS) is a follow-back survey encompassing 6,386 reports of fetal death or certificates of fetal death. These vital records are based on a two-in-five sample of the fetal deaths which occurred in 1980 with gestation of 28 weeks or more, or delivery weight of 1000 grams or more. The report of fetal death or certificates of fetal death represents the basic source of information in this survey. Married mothers, hospitals, attendants at delivery, and providers of radiation examinations and treatments were contacted under the same conditions as those described above for the 1980 NNS. The same questionnaire forms [redacted] in both surveys.

A national follow-back survey based on fetal death records had not been conducted previously. A pretest conducted prior to the 1980 survey indicated that it was feasible to collect substantially the same information about fetal deaths as that collected about live births. The large proportion of fetal deaths was chosen to provide similar numbers of live births and fetal deaths, thereby facilitating the comparison of deliveries by outcome.

These data are used to define medical risk indicators for women and for infants under 6 months of age. The indicators for infants are based on birth data, such as low birth weight, prematurity, and congenital abnormality. In addition, because the survey includes both mother and newborn measurements, the conditions of the mother which would have made her eligible for WIC benefits can be defined as a risk indicator for infants.

Hematology: Variable Definitions and Definitions of Risk Indicators

The principal measures of risk of anemia are assessments of the concentration of hemoglobin and hematocrit obtained in blood assays. Tables D-3 and D-4 present the distribution of hemoglobin and hematocrit levels in the NHANES-II sample of women aged 12-49 years. Tables D-5 and D-6 present the distribution of hemoglobin and hematocrit levels in the NHANES-II sample of infants and children aged 1 through 4 years. Table D-7 further breaks down hemoglobin and hematocrit distributions by age groups for infants and children.

As seen in tables D-5 and D-6, there is an extensive amount of missing hematological data (n=896, of the 3357 cases available) for infants and children. In these cases, no blood samples were obtained and consequently no information on blood chemistry exists. In the medical history questionnaire, however, information is available on prior anemia that can be used to impute a risk indicator value for infants and children with missing hematological data. Thus to avoid reducing the sample size so significantly, the following approach was implemented. The imputation of the anemia risk indicators for the NHANES-II sample of 896 children aged 6 months to 5 years who had

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Table D-3. Distribution of Hemoglobin Levels (g/100 ml) Among Women Aged 12-49 Years in the NHANES II Sample (n=4382)

	n	Percent
8.9 or less	9	0.2
9.0 - 9.9	16	0.4
10.0 - 10.9	61	1.4
11.0 - 11.9	325	7.6
12.0 - 12.9	1128	26.3
13.0 - 13.9	1584	36.8
14.0 - 14.9	916	21.3
15.0 - 15.9	230	5.4
16.0 and above	27	0.6
Total	4296	100.0

Missing Data - 86 (2.0 percent of 4382).

Table D-4. Distribution of Hematocrit Levels (100%) Among Women Aged 12-49 Years in the NHANES II Sample (n=4382)

	n	Percent
29.9 or less	17	0.4
30.0 - 32.9	50	1.2
33.0 - 35.9	360	8.4
36.0 - 38.9	1305	30.3
39.0 - 41.9	1712	39.9
42.0 - 44.9	710	16.5
45.0 - 47.9	133	3.1
48.0 or more	9	0.2
Total	4296	100.0

Missing Data - 86 (2.0 percent of 4382).

Table D-5. Distribution of Hemoglobin Levels (g/100 ml) Among Infants Aged 6-12 Months and Children Aged 1-4 Years in the NHANES II Sample (n=3357)

	n	Percent
8.9 or less	6	0.2
9.0 - 9.9	25	1.0
10.0 - 10.9	211	8.6
11.0 - 11.9	833	33.8
12.0 - 12.9	988	40.2
13.0 - 13.9	348	14.1
14.0 - 14.9	46	1.9
15.0 - 15.9	4	0.2
16.0 or above	-	-
Total	2461	100.0

Missing Data: 896 (26.7 percent of 3357).

Table D-6. Distribution of Hematocrit Levels (%) Among Infants Aged 6-12 Months and Children Aged 1-4 Years in the NHANES II Sample (n=3357)

	n	Percent
29.9 or less	21	0.9
30.0 - 32.9	260	10.6
33.0 - 35.9	1086	44.0
36.0 - 38.9	894	36.3
39.0 - 41.9	179	7.3
42.0 - 44.9	17	0.7
45.0 - 47.9	4	0.2
48.0 or more	-	-
Total	2461	100.0

Missing Data - 896 (26.7 percent of 3357).

missing hematology data was based on responses to 4 questions concerning prior anemia from the medical history questionnaire.

(1) Has ___ ever had anemia?

(2) Did a doctor tell you that ___ had anemia?

(3) Was ___ treated for this condition by a doctor?

(4) Is ___ still being treated for it?

Table D-7. Distribution of Hemoglobin and Hematocrit Levels by Age Groups in NHANES-II Sample of Children (n=3357)

	Age Groups				
	6-11 mos (n=207)	12-23 mos (n=459)	24-35 mos (n=520)	36-47 mos (n=613)	48-59 mos (n=662)
Hemoglobin (g/100 ml)					
90th percentile	13.0	13.1	13.2	13.1	13.4
75th percentile	12.4	12.6	12.7	12.6	12.9
Median	11.8	12.0	12.0	12.1	12.3
25th percentile	11.2	11.2	11.5	11.6	11.7
10th percentile	10.6	10.6	10.9	11.1	11.2
Hematocrit (%)					
90th percentile	38.7	38.5	38.2	38.1	39.0
75th percentile	36.5	37.0	37.0	37.0	37.3
Median	35.0	35.2	35.2	35.2	35.7
25th percentile	33.2	33.7	34.0	34.0	34.5
10th percentile	32.0	32.0	32.5	32.7	33.2

All children with missing hematology data who had information on the four medical history questions (n=886 of 896 total) were used for the imputation. The imputation procedure accepted as "at risk" all children who were still

being treated for anemia (information that the child had ever had anemia was not deemed to be sufficient to consider the person at risk). Persons who had never had anemia (responding "no" to question 1), for whom a doctor had not told them they had anemia ("no" to question 2), whom a doctor had not treated for anemia ("no" to question 3), or who were not still under treatment at the time of the interview ("no" to question 4) were judged not to be at risk. The following breakdown of the 896 cases was obtained:

	n	Anemia Risk Indicator Value
Missing data on questions 1-4	10	missing
Never had anemia (responding "no" to question 1)	801	not at risk
Not diagnosed by doctor (responding "no" to question 2)	16	not at risk
Not treated by doctor (responding "no" to question 3)	8	not at risk
Not still under treatment (responding "no" to question 4)	39	not at risk
Still under treatment (responding "yes" to question 4)	22	at risk
Total	896	

Anthropometry: Variable Definitions and Definition of Risk Indicators

In contrast to indicators of nutrition-related risk in other domains, anthropometric definitions of risk are very similar across the various State WIC Program Plans of Operation. All involve comparisons of weight (and for children, of height) to norm reference standards. Measures of both height and weight are available for the entire NHANES-II sample.

Anthropometric Measures for Women 12-49 Years of Age

A single anthropometric measure is used to derive risk indicators for the NHANES-II sample women; the measure is the ratio of weight to the median weight for women of the same height (or median weight-for-height). The distribution of this ratio, converted to a percentage, is presented in table D-8.

Interpolation was used to adjust the reference standards of women 12-49 years of age. Norm reference standards, obtained from the Metropolitan Life Insurance Company tables[2], were fit to a linear regression equation in order to extrapolate to the range of heights (128-188 cm) in the NHANES II sample of women. Interpolation was used between the norm reference standard points (1 inch apart) to provide median weights to the nearest centimeter. Since the norm standards refer to women 25 years of age and older they had to be adapted to women in the age range 12-24 years. (The tables state that in the age range 18-24 years, 1 pound must be subtracted for every year under 25, at all heights.)

Two risk indicators are defined for women aged 12-49 years: underweight and overweight. Indicators of risk due to insufficient and excessive weight use percentages of weight over median weight-for-height (corrected for pregravid weight, in pregnant women). For underweight, the WIC modal criterion level

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[2]"Desirable Weights" Table, Metropolitan Life Insurance Co., 1959, Journal of the American Medical Association, 14:134 (1960).

used to define nutritional risk is 90 percent of weight-for-height, for overweight, the level is 120 percent of weight-for-height[3].

In pregnant women, the appropriate weight to use for risk indicators is pregravid weight. Weight at the point of conception or before is not available in NHANES-II; for this reason, it was necessary to impute a correction for pregravid weight. The correction procedure used minimal estimates of monthly weight gains, derived from desirable weight gains found

Table D-8. Distribution of Percentage of Weight Over Median Weight-for-Height (adjusted) Among Women Aged 12-49 Years in the NHANES-II Sample (n=4382)

	n	Percent
70% and less	1	0.02
71% - 80%	61	1.39
81% - 90%	481	10.98
91% - 100%	914	20.86
101% - 110%	1021	23.31
111% - 120%	706	16.11
121% - 130%	427	9.74
131% - 140%	233	5.32
141% - 150%	186	4.24
151% and above	352	8.03
Total	4382	100.00

[3]Weight is measured in NHANES with respondents wearing paper gown and slippers while the Metropolitan Life standard tables reflect normally clothed weight. No adjustment was made for this discrepancy in assessing the risk status of women from the NHANES data. Consequently, the risk-factor measure for abnormal weight (individual's weight-for-height as a percent of median wt/ht) was consistently slightly understated. This results in slightly overestimating the frequency of underweight women and slightly underestimating the frequency of overweight women from the NHANES data in terms of WIC risk criteria. The size of these particular biases was estimated to be quite small and their effect for the estimated overall frequency of risk, under all risk criteria combined, is judged to be imperceptible.

in various State plans and consultation with a medical doctor trained in nutrition (Parillon, personal communication, 1984). The formula used was:

Pregravid Weight = Current Weight - Adjustment,

where:

Adjustment = 1.33 (kg) x no. months pregnant, if 3 or less

or = 4 + 1 (kg) x (no. months pregnant - 3), if 4 or more.

This adjustment assumed minimal weight gains of 1.33 kg (3 lbs.) per month over the first 3 months of pregnancy, and 1 kg (2.2 lbs.) per month over the next 6 months.

Anthropometric Measures for Infants 6-11 Months and Children 1-5 Years Old

Measures of weight and height are used to establish anthropometric risk indicators for infants and children. Four measures are offered in State plans as indicators of anthropometric risk:

- Overweight: weight greater than 90th percentile of weight-for-height standard and,
- Underweight (1): weight below 10th percentile of weight-for-height standard and,
- Underweight (2): weight below 10th percentile of weight-for-age standard and,
- Stunted growth: height below 5th percentile of height-for-age

standard for infants aged 6-11 months and below 10th percentile of height-for-age standard for children 12-59 months of age.

Height data in the NHANES-II data base were obtained by recumbent lengths (for children aged 2 and below) and standing height for children above 2 years of age. Recumbent length was used to create risk indicators below 2 years of age and standing height was used at 2 years of age and above. The corresponding standards were taken from World Health Organization (WHO) publications. In creating a single uniform scale of heights-for-age, values corresponding to the interval between 22 and 36 months were given minor adjustments to create a smooth transition.

Medical/Clinical Conditions: Variable Definitions and Definition of Risk Indicators

Among the variables available in the NHANES-II data base, a number refer to pregnancy history, medical history, or chronic or current conditions that determine certification into the WIC Program. These variables, and the risk indicators formed from them, are discussed below.

Medical History and Clinical Variables for Women 12-49 Years of Age

Two variables in the NHANES-II Medical History Questionnaire and Health History Supplement that deal with past pregnancies relate to potential conditions of nutritional risk for women, and therefore are possible grounds

for admission into the WIC Program. These variables are: number of prior pregnancies and number of prior miscarriages.

Diabetes is assessed in NHANES-II by asking if a doctor told the respondent that they had diabetes. Renal disorders are assessed in NHANES-II through the questionnaire, with many questions about specific conditions. Ten questions were used to create a risk indicator for renal disorders:

- Did a doctor ever tell you that you had chronic kidney disease?
- Have you ever had kidney stones?
- About how many times did the infections involve the kidney?
- Did a doctor ever tell you that you had nephritis?
- Did a doctor ever tell you that you had renal sclerosis?
- Did a doctor ever tell you that you had kidney stones or stones in the ureter?
- Did a doctor ever tell you that you had nephrosis?
- Did a doctor ever tell you that you had kidney abscess?
- Did a doctor ever tell you that you had hydronephrosis?
- Did a doctor ever tell you that you had kidney infection?

The risk indicator for chronic medical conditions defined in NHANES-II is a compilation of the following disorders: arthritis, gout, chronic bronchitis, emphysema, tuberculosis, rheumatic fever, rheumatic heart disease, heart failure, heart attack, other heart trouble, hardening of the arteries, gastric ulcer, recurrent or chronic enteritis, ulcerative colitis, spastic colon/mucose colitis, gallstones, hepatitis, yellow jaundice, chronic cough,

pleurisy, low blood pressure, cataracts, glaucoma, thyroid disease, polio or paralysis, diaphragmatic hernia, goiter, cancer, blood not clotting properly, loss of blood from stomach or bowels, recurrent persistent cough, liver/gall bladder condition, stroke, ischemic heart disease, other heart disease, cardiovascular disease, ateriosclerosis, and other circulatory disorders. The risk indicator for these multiple-question items was defined as present if at least one chronic condition was present in the data. Risk criteria which were included in other indicators (such as anemia or hypertension) were excluded from the derivation of chronic conditions.

Medical History and Clinical Variables for Infants (6-11 Months of Age) and Children (1-5 Years of Age)

Three risk indicators for infants and children are defined in NHANES-II, based on prior medical history and current conditions. These three risk indicators are: congenital conditions, frequent respiratory/intestinal problems, and other chronic or serious medical conditions.

Five questions in the Medical History Questionnaire for infants and children in NHANES-II that deal with congenital malformations or conditions of some seriousness were used to generate a risk indicator for congenital conditions. These questions are:

- Does or did ___ have any conditions he/she was born with that involved his/her heart?

- Does or did ___ have any conditions he/she was born with that involved his/her mouth or throat?
- Does or did ___ have any conditions he/she was born with that involved his/her kidneys or urinary system?
- Does or did ___ have any conditions he/she was born with that involved his/her brain or nervous system?
- Has ___ ever been treated for congenital heart disease?

Several other questions relating to congenital conditions were also asked in the Medical History Questionnaire, but were excluded from the risk indicator variable for various reasons. Conditions related to eyes or ears, for example, were excluded because the exact condition found was not specified and most of the conditions potentially included would not cause the infant or child to be judged at nutritional risk (Parillon, 1984; personal communication). Likewise, conditions related to stomach or intestines, muscles, bones or joints, or to other conditions were excluded for similar reasons. Persons with one or more of the congenital conditions identified were considered to be at risk.

Seven variables from the children's Medical History Questionnaire were used to generate a risk indicator for frequent or serious respiratory or intestinal problems:

- How many times has ___ had pneumonia?
- During the past 6 months how many colds has ___ had?
- During the past 6 months how many times has ___ had diarrhea?

- Has ___ ever been treated for tuberculosis?
- Has ___ ever been treated for any other chest or lung conditions?
- Has ___ ever been treated for stomach or intestinal disorders, excluding diarrhea or flu?
- How many times has ___ had an ear infection?

For several of these variables, the definition of the "at risk" group required the interpretation of the WIC modal risk criterion by a medical doctor trained in nutrition (Parillon, 1984). Infants and children were considered at risk if they reported two or more episodes of pneumonia, four or more colds in the past 6 months, four or more episodes of diarrhea in the past 6 months, or four or more ear infections. For the remaining variables, infants and children were considered at risk if they had ever been treated for the conditions. Infants and children were judged at risk if they were at risk on one or more of the variables.

Other chronic or serious conditions were assembled into a risk indicator by examining responses from 11 questions on the children's Medical History Questionnaire:

- Has ___ ever been treated for rheumatic heart disease?
- Has ___ ever been treated for any other heart condition?
- Has ___ ever been treated for diabetes?
- Has ___ ever been treated for epilepsy or convulsions?
- Has ___ ever been treated for liver disorder?
- Has ___ ever been treated for thyroid disease or goiter?
- Has ___ ever been treated for cancer or tumors?

- Did a doctor ever tell you that ___ had asthma?
- Did a doctor or other specialist ever tell you that ___ had polio or paralysis?
- Did a doctor or other specialist ever tell you that ___ had cerebral palsy?
- Did a doctor or other specialist ever tell you that ___ had any type of brain damage?

Regarding asthma, the responses to the question also specified whether the child still had asthma at the time of the interview; only those children who currently had asthma were judged at risk. As for other clinical variables, persons with a positive response on one or more of the variables were considered at risk on this indicator.

Inappropriate Dietary Pattern

The nutritional-risk criterion of inadequate or inappropriate dietary pattern, used to certify WIC Program eligibility in the lower-priority levels IV-VI, shows greater variation among States than any other risk criterion. The various definitions presented in the State plans are shown in table D-9.

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Table D-9. Weighted Frequencies of the Definition of Inappropriate Dietary Pattern Defined in the 1984 Annual State Plans

Inappropriate Dietary Pattern	% States Using[a] These Criteria
(1) at least one of six basic nutrients (calories, protein, iron, vitamin A, vitamin C, calcium) at or below 2/3 of the RDA	1.8
(2) at least one of six basic nutrients (calories, protein, iron, vitamin A, vitamin C, calcium) at or below the RDA	29.1
(3) insufficient servings of four basic food groups (meats, breads and grains, vegetables and fruits, dairy products)	50.4
(4) definitions such as "inappropriate as determined by nutritionist"	27.0
(5) pica	25.1
(6) food allergies	12.3
(7) dental caries	16.6
(8) excessive vitamin intake	1.0

[a]percentage is weighted by the estimated WIC income-eligible population in each State.

The predominant practice is to define inadequate daily servings of one of the four basic food groups, assessed either from 24-hour recall or daily-average-food-frequency recall, as the criterion for diet-based nutritional risk.

The modal values for this dietary risk criterion were as follows:

	for children	for pregnant women
breads and cereals	<4	<3
fruits and vegetables	<4	<3
milk and dairy products	<3	<2
meats and protein sources	<2	<1

The dietary risk indicator was defined in a similar fashion for women and children from the NHANES-II data base, which contains 24-hour-recall and weekly-food-frequency-recall data for both groups. The food-frequency questionnaire was used in defining the risk indicator for inappropriate dietary patterns since the modal State plan defined the most common dietary risk indicator to be insufficient servings of the four basic food groups. Three steps were required to convert the NHANES-II food-frequency information to dietary-risk indicators: (1) converting food consumption frequencies to servings per day, (2) aggregating specific foods into food groups, and (3) comparing food intake to recommended servings per food group.

Food consumption frequencies are obtained in the NHANES-II survey by asking respondents how often they consume each specific food type under usual circumstances.

The food frequency questionnaire asked: how often do you consume the following foods:

(1) Milk and milk products
    Whole milk
    Skim milk or buttermilk
    Ice milk, ice cream, puddings
    Cheese and cheese dishes

(2) Meat
(3) Poultry
(4) Organ meats
(5) Fish and shellfish
(6) Eggs
(7) Soups, sauces, gravies
(8) Fats and oils
(9) Legumes, nuts, seeds
(10) Cereals and grain products
(11) Fruits and vegetables
    Fruits and vegetables rich in vitamin A
    Fruits and vegetables rich in vitamin C
(12) Sugar and sugar products
(13) Desserts and sweets
(14) Mixed dishes
(15) Alcoholic beverages
    Wine
    Liquor
(16) Sugar free/low calorie beverages
(17) Coffee or tea
(18) Salty snacks
    Potato chips
    Corn chips
    Popcorn
    Etc.

The responses to each question could be:

(1) Never
(2) Less than once a week
(3) Number of times per week (from one to six)
(4) Number of times per day (from one to seven)
(5) Unknown

The responses were initially examined for each individual food to calculate the number of times a particular food was consumed per day. The assignment of the number of times a food was consumed per day on average was as follows:

	Response to Questions 1-18	Number of Times Consumed per Day
(1)	Never	0
(2)	Less than once a week	1/7
(3)	One time per week	1/7
	Two times per week	2/7
	Three times per week	3/7
	Four times per week	4/7
	Five times per week	5/7
	Six times per week	6/7
(4)	One time per day	1
	Two-Seven times per day	2-7, respectively
(5)	Unknown	0

The estimated daily servings obtained for each specific food were then summed across food groups for comparison with the criterion level of servings according to the modal State plan. For example, if a person reported drinking milk twice a day and eating ice cream once a day, a total of three servings would be obtained for the food group "milk and milk products." The food groups for this risk indicator were defined from the NHANES-II data as:

- Milk and milk products: whole milk; skim milk or buttermilk; ice milk, ice cream, puddings made with milk; and cheese and cheese dishes.
- Meats, fish, and eggs: meat, poultry, organ meats, fish and shellfish, and eggs.
- Fruits, vegetables, and legumes: all fruits and vegetables, legumes, nuts and seeds.
- Cereals and grain products: cereals, breads, and grain products.

If any two or more of the four basic food groups were deficient as defined by the modal State plan, the individual was assigned a positive value for the

Inappropriate Dietary Pattern risk criterion. Table D-10 presents the breakdown of the consumption of the four basic food groups in the diets of the sample of children aged 12-59 months and the sample of women aged 12-49 years from the NHANES-II survey data.

Table D-10. Percentages of Women & Children, by Average Servings Per Day from Four Basic Food Groups, NHANES-II

Average Number of Servings Per Day	Milk and Milk Products	Meats, Fish, and Eggs	Fruits, Veg's and Legumes	Breads and Cereals
Women, Age 12-49				
0	28.1	16.9	5.3	9.4
1	28.7	54.1	38.6	33.8
2	22.7	23.4	31.2	34.7
3	13.4	4.7	17.6	17.7
4+	7.1	0.9	7.3	4.4
Children, Age 1-5				
0	2.0	1.2	2.7	0.7
1 or 2	29.8	80.9	54.3	47.6
3+	68.2	17.9	43.0	51.7

[a] Specific foods aggregated into food groups. Data are based on responses to the NHANES-II food-frequency questionnaire, and refer to "usual" number of servings, averaged to daily basis.

APPENDIX E

STATISTICAL FORMULATION AND RESULTS OF THE NUTRITIONAL RISK MODEL USED TO ESTIMATE THE PROPORTION OF PERSONS AT NUTRITIONAL RISK

The determination of eligibility to participate in the WIC Program includes the assessment of abnormality in biochemical measurements, anthropometric measurements, present medical conditions, pregnancy histories and/or dietary patterns. When an abnormality is assessed on any one or more of these dimensions for an individual, that individual is said to be at nutritional risk. In some cases, the measurement of the child (or mother) will qualify the mother (or child), respectively, to participate in the WIC Program. For example, an infant born to a mother who participated in WIC during her pregnancy is eligible to participate for the first 6 months of that infant's life.

In the context of the WIC Program, nutritional risk is an operational concept that identifies an individual as liable to experience an increased chance of poor pregnancy outcome or poor health and development because of risk factors which may be intensified by inappropriate or inadequate food intake. From an operational viewpoint, the presence of any of the specified risk conditions is sufficient to judge a person as being at nutritional risk. From a statistical point of view, however, counting according to the presence of any risk indicator overestimates the size of the population at risk by the degree of coincident occurrence of risk indicators in population groups. Consequently,

special statistical methods were developed for the WIC Eligibility Study to solve this fundamental estimation problem.

The estimation model that was developed for the frequency or prevalence of nutritional risk within a given population group under a given set of risk criteria employed statistical methods that reflect explicitly the categorical nature of the risk indicators and their joint dependence on each other. It is a two-step model in which the two steps used in estimating the proportion of the population at nutritional risk are based on logistic regression.

The logistic multiple regression model, as presented in Walker and Duncan (1967), was used to predict the categorical variables for nutritional risk, which can be either dichotomous or ordered polychotomous. The general model is of the form:

$$PROB(Y \geq J) = 1/(1 + \exp(-A + XB)$$

where J = 1, 2, ...K and A is a vector of parameter estimates of order K, X is an n by m data matrix, B is a vector of parameter estimates of order m, n is the number of observations in the data, and m is the number of predictor variables in the model.

For example, Y could be a variable coded "0" if a pregnant woman were not at risk on some risk indicator and "1" if she were at risk on that indicator. The model would be used to analyze data about pregnant women for whom this risk indicator had been observed and recorded, and the presence or absence of

the indicator was hypothesized to be statistically related to other variables such as sociodemographic characteristics. The statistical procedure based on this formulation estimates the probability of observing the presence of the risk indicator for a given pattern of sociodemographic characteristics which are represented by the matrix X. In the case where J > 1, the estimated parameters lead to measures of the probability of obtaining an ordered value of at least J. Since the logistic regression model has far fewer assumptions than the linear discriminant model (e.g., no multivariate normality assumption for covariates), the logistic regression is often preferred over discriminant analysis (see Press and Wilson, 1978). The model requires no assumption about what differences between categories mean on an interval scale. For the sake of clarity in what follows, the notation:

$$Y = L(X_1, X_2, X_3, \ldots X_m)$$

will denote the mathematical representation of the logistic regression model, with Y being the categorical dependent variables (e.g. risk indicator or admission score) and X_1 through X_m representing the list of predictor variables in the data.

The ordered logistic model was implemented in SAS; the implementation gives simple statistics (mean, minimum, maximum, range) for each independent variable and calculates maximum likelihood estimates for the parameters associated with each independent variable (F. Harrell, 1979). The chi-square statistic for testing the hypothesis that a parameter is zero assumes that the estimators are asymptotically normally distributed. The model likelihood

ratio chi-square and its p-value and degrees of freedom and a statistic called R which measures the fit of the model are also calculated. It is identical to the likelihood ratio chi-square for a 2x2 contingency table when there is one binary variable in the model and the dependent variable is also binary. The R statistic is akin to the multiple correlation coefficient in ordinary least squares, after a correction is made to penalize for the number of parameters estirated. As such, the model results can generally be interpreted in a fashion similar to ordinary least squares multiple regressions, except that the predicted value estimated is a probability.

Step 1. Identification of Maximally Prevalant and Coincident Indicators

Since the available data sets have insufficient observations to directly estimate the independent occurrence of each risk indicator in the WIC potentially eligible population, (i.e., eligible on categorical and income criteria) the method which was developed for the project first identified, and sequentially ordered, the available risk indicators in terms of the relative frequency with which each one separately would admit persons at risk into eligibility for the WIC Program. In this formulation, each risk indicator is represented as a binary variable indicating the presence or not of some "risk" condition, as defined under the specified set of nutritional risk criteria. The statistical procedure for this step consisted of identifying the maximally prevalent risk indicators among all the risk indicators in a given survey data set (NHANES-II or National Natality and Fetal Mortality Survey) for all women of childbearing age, all infants, and all children up to 5 years old in that

particular data set. The degree of prevalence of risk indicators also corresponds closely to the degree of coincident occurrence among indicators; that is, the maximally prevalent indicators tend to co-occur with greatest frequency with other less prevalent risk indicators. Consequently, the ordering of risk indicators by maximal prevalence also represents an ordering by maximal coincident occurrence.

The ordering of risk indicators determined by this step was carried out by identifying the particular indicator that when used singly and independently selected the largest number of "at-risk" persons in the data set. The observations in the data with this risk indicator were then assigned the highest "admission score" for WIC eligibility status, i.e., would admit the largest number of persons at risk. The remaining persons and risk indicators in the data were then submitted to the same inspection to select the second risk indicator with maximal prevalence among the remaining observations. This procedure continued until all observations within a given data set which exhibited at least one risk indicator were selected or the risk indicators were exhausted. This process takes K sweeps, depending on whether the sample involves infants, children, or women, in which K equals the number of separate nutritional-risk indicator variables utilized from the available data. The observations selected in the first sweep were assigned a score of K. Subsequent selections were assigned admission scores in descending order, and the observations without any recorded risk indicator received an admission score of zero. This process defined an "admission score" variable that was ordered according to maximal prevalence and coincident occurrence among the available risk indicators. These ordered categorical variables provided the

dependent variables for the second-step logistic regressions, which estimated the proportions of the various income-eligible WIC categorical population groups that would be found to be at nutritional risk under the specified set of risk criteria defined for each group.

Step 2. Estimation of Proportions of the Population at Risk

The ordered categorical variable obtained in step 1 was fit to logistic multiple regression models in which the independent variables were the population unit characteristics: race, age, income, and WIC Program categorical subgroups and other demographic and regional variables. These were selected to allow imputation to the lowest possible level of disaggregation available in the survey data that could then be mapped directly to the Census data for each geographic area. For example, for women this model was of the form:

$$Y = L_{\Sigma}\ (\text{group, age, race, income, group by age, group by race, group by income, age by race, age by income, race by income, region, urban...})$$

where group = WIC Program category subgroup: pregnant women, breastfeeding women; postpartum women,

Age = 12-18 years,
19-26 years,
27-35 years and
36 years and above;

Race = Non-Hispanic, White,
Non-Hispanic, Black,
Hispanic, and
Other;

Income = Less than 100% of poverty level,
100-130% of poverty level,
130-185% of poverty level, and
over 185% of poverty level;

Y = ordered admission score.

The model for children was of the form:

Y = L (age, race, income, age by race, age by income, race by income, region, urban...)

where age = 0-6 months, 7-11 months, 12-23 months, 24-35 months, 36-47 months, 48-60 months

and race and income are as defined in the model for women.

The set of all significant variables in the model determined the maximum reticulation at which the predicted probability of at least one risk indicator being present was calculated. This model was used to calculate a table of proportions of persons likely to be at nutritional risk under the given set of risk criterion definitions. This table contains the multipliers for the Census counts of persons eligible on categorical and income grounds, to yield the estimated number of persons fully eligible to participate in the WIC Program based on the Program's nutritional risk criteria as well as on categorical and income requirements.

Use of Weighted Analyses

In estimating the proportions of the WIC population groups at nutritional risk from NHANES and NNS data, sample weights and complex sample design were included in the estimation process. The sample weights were used to estimate means, proportions, and other descriptive statistics. The sample weights and the design strata and primary sampling units were incorporated in the tests of statistical significance through the use of weighted logistic regressions (Shah, 1984).

It was important to utilize sample weights because, by survey design, each person in the samples represents a number of people in the U.S. population. If each sample person representated the same number in the population, i.e., had equal probabilities of selection, the data would be self-weighting and the use of sample weights would not be necessary for the analysis. In the case of these surveys, the selection probabilities are not equal and thus weights encompassing sample selection probabilities and nonresponse adjustments were applied in both step 1 and step 2 determination of nutritional risk.

It was also important to account for sampling design when establishing statistical significance, since if simple random sampling is assumed, it usually leads to smaller variances than those estimated by taking into account the complex sample design. The design effect measures the impact of complex sample designs on variances. It is defined as the ratio of the variance of a statistic from a complex sample to the variance of the same statistic from a simple random sample of the same size, i.e.,

$$\text{Design} = \frac{\text{Variance (Complex Sample)}}{\text{Variance (Simple Random Sample)}}$$

If the design effect is close to a value of one, the complex sample design has little effect on the variances and there is no need to account for design in the analyses. For NHANES-I, however, the design effects were rarely near one and their size was somewhat inconsistent (Landis et al., 1982; Kovar, 1984). Kovar has noted that, "one might expect that in smaller population groups the people would be more homogeneous and the design effect would be reduced. That was often the case for age groups where the variable under consideration was

correlated with age, but even there the design effect was not negligible." This corresponds closely to the nature of the analysis for the WIC Eligibility Study, since inferences are desired for individuals in specific age/sex categories.

According to Landis et al. and Kovar, three possible options exist for analysis of large data bases: using the sample counts and assuming simple random sampling (option 1), incorporating the weights and assuming simple random sampling (option 2), and incorporating both the weights and complex sample design (option 3). Both options 2 and 3 are based on weighted data, thus the means, proportions, and prevalences of variables would be the same, though not the same as the unweighted analysis in option 1. The variances and standard errors would be different for option 3, which incorporates the complex sample design. Since the standard errors vary dependent on which option is analyzed, the test statistics for regression analyses are also affected. Incorporating the complex sample design results in larger standard errors of the coefficients and, consequently, smaller t-statistics, which would tend to make relationships that may be significant under the assumption of simple random sampling insignificant when the complex sample design is taken into consideration.

Kovar and Landis et al. have presented analytical strategies for the analysis of NHANES data using options 1 through 3. Kovar states, "the data analyst with the public-use data tape can use any of the three options. However, option 1 can lead to incorrect estimates and variances, while option 2 should lead to correct estimates but inappropriate variances. Option 3 should lead

to both correct estimates and appropriate variances, but option 3 requires more statistical expertise and more computer time than the other options." In addition, the user of the public-use tapes must restrict the analysis to the available data on the tapes. Therefore, the user can only use a variation of option 3 because the full variance-covariance matrix for all available variables is too extensive and not available to users; the off-diagonal elements of this matrix, the covariance terms, are thus assumed to be zero.

Following the guidelines of Kovar, "the best strategy seems to be to explore hypotheses and eliminate inconsequential variables under option 2. To avoid eliminating variables that might be significant in the final analysis, the p-value should be higher than the value that will be used for the final inferences. Setting the p-value higher, say 0.10 or 0.15 rather than 0.05, will protect the analyst from incorrectly eliminating a variable where the design effect is less than 1..."

In order to produce population estimates of means, proportions and prevalences, the use of the sample weight is relatively straightforward with standard statistical packages such as SAS. For this study, these point estimates are the important results which are used to develop the estimates of proportions of the population at nutritional risk in each geographic unit. Confidence intervals for the estimated proportions provide another test of the variability of these estimates. They are computed in the following manner: let B_i be a significant coefficient from the solved logistic regression equation of step 2. Then there is a pair of boundary values B_iL^* and B_iU^* such that:

$$B_iL^* < / B_i / < B_iU^*$$

The B_i^* are defined in terms of standard error unit distances from B_i. Y_l^* and Y_u^*, upper and lower bound estimates of the proportion of persons at risk, can be generated by evaluating the solved logistic regression equation at B_iL^* and B_iU^*, with other parameters held constant at their point-estimate values.

Variances are also important in statistical tests of individual variables. The use of variables in the models was determined by adjusting the appropriate test statistic by the published design effects for related variables (Landis et al., 1982) as suggested in the Kovar strategy. For example, p-values for estimates were recomputed by multiplying "t" statistics by the square root of the design effect and chi-square statistics by the design effect. These adjustments were not necessary in the first step of the estimating procedure since what was being sought is maximal prevalence and coincidence of indicators within the sample. They were critical in step 2, however, for obtaining accurate and reliable statistical estimates for mapping onto the U.S. Census data. This mapping was accomplished through the use of the common socioeconomic and demographic variables in each of the survey data sets.

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Table E-1. Frequency of Nutritional Risk Indicators[a], Women Aged 12 to 49 Years, by Age Group (NHANES-II, n=4161)

Medically Based Nutritional Risk Indicators	Age of Women				
	All	≤18	19-26	27-35	≥36
Anemia	2.3	2.0	2.7	1.6	3.1
Hypertension	8.7	2.7	3.6	7.4	19.9
Smoking Abuse	17.6	4.7	18.3	23.6	23.3
Alcohol Abuse	3.2	0.7	2.6	3.6	5.5
Diabetes	1.4	0.2	0.9	1.3	3.1
Renal Disorders	18.9	8.0	18.0	22.8	25.4
Chronic Conditions	11.3	3.7	6.2	11.9	22.4
Underweight	14.4	15.6	15.2	15.7	9.5
Overweight	24.1	15.3	19.9	26.1	34.6
History of Miscarriages	19.8	2.0	16.5	23.6	35.2
High Parity	10.0	0.0	0.8	9.5	21.5
Teenage Mother[b]	20.3	100.0	-	-	-
Older Mother[c]	29.4	-	-	-	100.0
Diet-Based Nutritional Risk Indicator					
Food Group Deficiency	59.1	56.1	61.9	60.2	60.1

[a] Weighted by sample weights to U.S. population frequencies.

[b] Accounts for 6.8 percent of pregnant women in NHANES sample.

[c] Accounts for 7.1 percent of pregnant women in NHANES sample.

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Table E-2. Frequency of Nutritional Risk Indicators[a]

Women Aged 12 to 49 years by Poverty Status
(NHANES-II, n=4161)

Medically Based Nutritional Risk Indicators	Poverty Income Status			Below 185% of Poverty Level	185% or more of Poverty Level
	Below 100%	100-129%	130-184%		
Anemia	3.6	1.1	1.9	2.4	2.2
Hypertension	10.1	11.0	9.0	10.2	7.8
Smoking Abuse	18.2	15.4	17.0	17.2	17.8
Alcohol Abuse	2.7	3.2	1.8	2.4	3.7
Diabetes	1.4	2.7	1.7	1.8	1.2
Renal Disorders	22.9	21.3	19.8	21.3	17.3
Chronic Conditions	11.0	10.2	10.9	10.8	11.6
Underweight	14.8	11.4	16.3	14.8	14.1
Overweight	29.9	31.8	24.8	28.1	21.6
History of Miscarriage	18.9	21.9	19.8	19.8	19.8
High Parity	17.6	16.6	12.8	15.4	8.2
Teenage Mother	24.4	24.3	25.5	24.8	17.3
Older Mother	21.6	26.9	28.1	25.3	32.1
Diet-Based Nutritional Risk Indicator					
Food Group Deficiency	64.5	64.3	55.6	63.3	56.6

[a] Weighted by sample weights to U.S. population frequencies.

Table E-3. Definition of Medical-Risk "Admission Score"[a] for Childbearing-Age Women, Based on the Ranking of Risk Indicators by Coincident Frequency[b]

Women Aged 12-49 years
(NHANES-II, n=4161)

Admission Score[a]	Medically Based Risk Indicators	Incremental Percentage of Women at Risk Under Successive Risk Indicators[b]
11	Overweight	24.1[c]
10	Underweight	14.4[c]
9	History of Miscarriages	11.5
8	Renal Disorders	7.8
7	Smoking Abuse	5.4
6	Chronic Conditions	2.2
5	Hypertension	1.2
4	Anemia	0.9
3	High Parity	0.8
2	Alcohol Abuse	0.4
1	Diabetes	0.1
0	Not at Medical Risk	31.0
Total, at-risk under any one or more criteria		69.0

[a] Assigned ordinal measure of coincident frequency; measures relative co-occurrence or "overlap" among risk indicators. Provides an ordered categorical dependent variable for logistic regression on population characteristics.

[b] Ordered incremental frequency of occurrence (weighted by sample weights). The incremental frequencies sum to the overall proportion of the population at risk under any one or more risk criteria.

[c] For the leading indicator in the sequence (overweight), and also for the second indicator (underweight, owing to its mutually exclusive relationship with the first indicator), the incremental frequency is the same as the population frequency for each indicator independently (Table E-1).

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Table E-4. Estimation of the Medical-Risk Admission Score as a Function of Population Characteristics[a]

Women Aged 12 to 49 Years
(NHANES-II, n=4161)

Dependent Variable: Ordered Medical-Risk Admission Score		
Independent Variables	Beta	Chi-Square
Intercept	-0.184	0.87
Income Level		
<100%	0.296	8.04**
100-129%	0.290	4.19**
130-184%	0.192	3.62*
Age		
19-26 years	0.707	14.36**
27-35 years	1.390	53.13**
36 years	1.990	101.74**
Race		
Black	0.283	5.94**
Other	-0.350	1.57
Hispanic	-0.046	0.09
Region		
Northeast	-0.088	0.55
Midwest	-0.008	0.01
South	-0.015	0.02

[a] Logistic regression of ordered categorical risk variable ("admission score") on population characteristics (population-weighted data).

*Significant at the 0.10 level of significance.
**Significant at the 0.05 level of significance.

Model Chi-square = 495.5 with 12 degrees of freedom.

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Table E-5. Estimated Proportion of Women Aged 12 to 49 Years at Nutritional Risk Based on Medical Criteria Only (NHANES-II, n=4161)

Race/Age	Income Level (% Poverty)			
	<100%	100-129%	130-184%	185%+
All[a]				
< = 18	.506	.498	.472	.419
19-26	.702	.696	.671	.624
27-35	.822	.816	.800	.766
36+	.895	.894	.883	.859
12-49[b]	.720	.719	.704	.691
White				
< = 18	.487(.060)[c]	.485(.077)	.462(.060)	.413(.048)
19-26	.689(.052)	.688(.066)	.666(.054)	.621(.044)
27-35	.815(.040)	.813(.050)	.798(.041)	.766(.036)
36+	.889(.028)	.888(.034)	.878(.029)	.856(.027)
12-49	.704	.708	.698	.689
Black				
< = 18	.558(.066)	.553(.087)	.534(.073)	.481(.071)
19-26	.747(.051)	.747(.068)	.726(.061)	.686(.060)
27-35	.854(.037)	.854(.047)	.839(.043)	.813(.044)
36+	.914(.025)	.914(.030)	.905(.029)	.888(.030)
12-49	.760	.763	.751	.739
Other				
< = 18	.406(.137)	.402(.145)	.381(.135)	.337(.124)
19-26	.609(.135)	.614(.139)	.590(.136)	.539(.135)
27-35	.761(.106)	.760(.110)	.740(.114)	.703(.115)
36+	.852(.072)	.852(.079)	.820(.088)	.811(.087)
12-49	.649	.638	.620	.589
Hispanic				
< = 18	.474(.084)	.478(.099)	.449(.087)	.405(.081)
19-26	.678(.074)	.683(.086)	.656(.080)	.613(.079)
27-35	.807(.056)	.803(.066)	.793(.060)	.759(.062)
36+	.883(.039)	.886(.043)	.874(.042)	.850(.045)
12-49	.707	.717	.696	.674

[a] The proportion of all U.S. women at risk is a weighted sum of the racially specific proportions; the weights were derived from the categorically eligible WIC population of women.
[b] Weighted sum of the age specific proportions.
[c] Measure of the 95% confidence bound above and below the point estimate.

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Table E-6. Definition of the Nutritional-Risk Admission Scores[a] For Childbearing-Age Women, Based on the Ranking of Medical and Dietary Risk Indicators by Coincident Frequency[b]

Women Aged 12 to 49 years
(NHANES-II, n=4161)

Admission Score[a]	Medically Based Risk Indicators	Incremental Percentage of Women at Risk Under Successive Risk Indicators[b]
12	Inappropriate Dietary Pattern	59.2
11	Overweight	8.8
10	Underweight	6.9
9	Total Miscarriages	4.6
8	Renal Disorders	3.4
7	Smoking Abuse	1.2
6	Chronic Conditions	1.0
5	Hypertension	0.4
4	Anemia	0.4
3	High Parity	0.2
2	Alcohol Abuse	0.2
1	Diabetes	0.1
0	Not at Nutritional Risk	13.6
Total, at risk under one or more criteria		86.4

[a] Assigned ordinal measure of coincident frequency; measures relative co-occurrence or "overlap" among risk indicators. Provides an ordered categorical dependent variable for logistic regression on population characteristics.

[b] Ordered incremental frequency of occurrence (weighted by sample weights). The incremental frequencies sum to the overall proportion of the population at risk under any one or more risk criteria.

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Table E-7. Estimation of the Medical-Plus-Dietary-Risk Admission Score for Women Aged 12 to 49 Years as a Function of Population Characteristics[a] (NHANES-II, n=4161)

Dependent Variable: Ordered Medical-Plus-Dietary-Risk Admission Score

Independent Variables	Beta	Chi-Square
Intercept	0.591	7.14**
Income Level		
<100%	0.610	16.92**
100-129%	0.218	1.44
130-184%	0.255	3.75*
Age		
19-26 years	1.125	28.95**
27-35 years	1.426	43.87**
36+ years	2.016	77.91**
Race		
Black	0.189	1.42
Other	-0.532	2.60
Hispanic	-0.150	0.61
Region		
Northeast	-0.044	0.09
Midwest	-0.008	0.00
South	-0.051	0.12

[a] Logistic regression of ordered categorical risk variable ("admission score") on population characteristics (population-weighted data).

*Significant at the 0.10 level of significance.
**Significant at the 0.05 level of significance.

Model Chi-square = 183.13 with 12 degrees of freedom.

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Table E-8. Estimated Proportion of Women Aged 12 to 49 Years at Nutritional Risk Based on Medical and Dietary Criteria Combined (NHANES-II, n=4161)

Race/Age	Income Level (% Poverty)			
	<100%	100-129%	130-184%	185%+
All[a]				
< = 18	.841	.777	.783	.734
19-26	.912	.873	.877	.846
27-35	.932	.901	.905	.881
36+	.961	.944	.945	.929
12-49[b]	.911	.874	.881	.862
White				
< = 18	.838(.045)[c]	.775(.068)	.783(.052)	.735(.048)
19-26	.912(.028)	.874(.045)	.878(.035)	.847(.033)
27-35	.933(.024)	.903(.038)	.907(.029)	.883(.028)
36+	.962(.015)	.944(.024)	.946(.019)	.931(.020)
12-49	.910	.874	.882	.863
Black				
< = 18	.863(.044)	.808(.072)	.817(.060)	.770(.067)
19-26	.927(.027)	.896(.045)	.898(.039)	.872(.043)
27-35	.945(.022)	.920(.037)	.922(.031)	.902(.035)
36+	.968(.014)	.954(.023)	.955(.020)	.943(.023)
12-49	.910	.896	.901	.883
Other				
< = 18	.752(.129)	.681(.157)	.677(.148)	.624(.151)
19-26	.858(.088)	.802(.114)	.808(.107)	.765(.118)
27-35	.890(.072)	.846(.097)	.850(.093)	.817(.100)
36+	.936(.047)	.908(.065)	.900(.088)	.889(.069)
12-49	.861	.804	.809	.776
Hispanic				
< = 18	.816(.067)	.753(.095)	.755(.084)	.704(.089)
19-26	.898(.043)	.857(.064)	.861(.056)	.828(.062)
27-35	.922(.035)	.890(.054)	.894(.046)	.867(.051)
36+	.955(.022)	.937(.034)	.938(.030)	.921(.034)
12-49	.899	.864	.867	.843

[a] The proportion of all U.S. women at risk is a weighted sum of the racially specific proportions; the weights were derived from the categorically eligible WIC population of women.
[b] Weighted sum of the age-specific proportions.
[c] Measure of the 95% confidence bound above and below the point estimate.

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Table E-9. Frequency of Nutritional Risk Indicators,[a] Postpartum Women, by Age Group (National Natality Survey, n=7484)

Medical Risk Indicator	Age of Women				
	All	≤18	19-26	27-35	≥36
Smoking Abuse	13.1	19.5	14.7	9.9	14.1
Alcohol Abuse	32.6	24.8	31.1	36.9	29.4
Chronic Conditions	18.7	13.5	17.6	20.1	27.2
History of Miscarriages	15.6	3.1	11.8	21.3	28.8
High Parity	7.6	0.0	3.1	11.7	20.5
History of Infant with Congenital Malformations	1.3	1.7	1.1	1.4	2.7
History of Low Birth Weight Infant	5.9	8.6	5.7	5.7	7.4
Closely Spaced Pregnancies	10.6	10.3	11.8	9.4	6.7
History of Multiple Births	1.9	1.0	1.7	2.3	2.5
Abnormal Weight Gain	18.5	21.4	20.1	16.5	12.4

[a] Weighted by sample weights to U.S. population frequencies.

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Table E-10. Frequency of Nutritional Risk Indicators[a]
Postpartum Women, by Breastfeeding Status
(National Natality Survey, n=7484)

Medical Risk Indicator	Never Breastfed	Breastfed Less than 6 months	Breastfed 6 months or more
Smoking Abuse	17.1	12.1	6.2
Alcohol Abuse	27.1	35.8	38.5
Chronic Conditions	19.1	18.9	17.3
History of Miscarriages	14.6	16.4	16.1
High Parity	8.4	6.3	8.4
History of Infant with Congenital Malformations	1.6	1.2	0.8
History of Low Birth Weight Infant	8.7	4.2	3.1
Closely Spaced Pregnancies	11.8	9.9	9.6
History of Multiple Births	2.3	1.8	1.4
Abnormal Weight Gain	16.9	20.6	17.9

[a] Weighted by sample weights to U.S. population frequencies.

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Table E-11. Definition of the Medical Risk "Admission Score"[a] for Postpartum Women, Based on the Ranking of Risk Indicators by Coincident Frequency[b]

Admission Score[a]		Medically Based Risk Indicators	Incremental Percentage of Women at Risk Under Successive Risk Indicators
10		Alcohol Abuse	12.8
9		Abnormal Weight Gain	11.9
8		Smoking Abuse	11.6
7		Chronic Conditions	9.1
6		History of Miscarriages, Abortions	9.1
5		High Parity	6.5
4		Closely Spaced Pregnancies	4.7
3		History of Low Birth Wt. Infant	3.4
2	<-	History of Infant with Congenital Malformations	1.9
1		History of Multiple Births	1.6
0		Not at Risk	27.3

[a] Assigned ordinal measure of coincident frequency; measures relative co-occurrence or "overlap" among risk indicators. Provides an ordered categorical dependent variable for logistic regression on population characteristics.

[b] Ordered incremental frequency of occurrence (weighted by sample weights). The incremental frequencies sum to the overall proportion of the population at risk under any one or more risk criteria.

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Table E-12. Estimation of the Medical-Risk Admission Score for Postpartum Women as a Function of Population Characteristics[a] (National Natality Survey, n=7484)

Independent Variables	Dependent Variable: Ordered Medical-Risk Admission Score Beta	Chi-Square
Intercept	1.45	75.68**
Income (% Poverty)		
<100%	.024	6.6**
100-129%	-0.02	0.0
130-184%	-0.08	1.2
Age (in Years)		
<18	-0.91	21.2**
18-26	-0.69	17.6**
27-35	-0.46	7.6**
Race		
Black	-0.08	0.7
Other	-0.46	9.8**
Hispanic	-0.18	3.4*
Region		
Northeast	0.09	1.4
North Central	0.28	16.5**
West	0.30	16.6**

[a] Logistic regression of ordered categorical risk variable ("admission score") on population characteristics (population-weighted data).

*Significant at 0.10 level of significance.
**Significant at 0.05 level of significance.

Model Chi-square = 80.44 with 12 degrees of freedom.

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Table E-13. Estimated Proportion of Postpartum Women at Nutritional Risk Based on Medical Criteria Only (National Natality Survey, n = 7484)

Race/Age	Income Level (% Poverty)			
	<100%	100-129%	130-184%	185%+
All[a]				
< = 18	.699	.634	.640	.654
19-26	.743	.695	.686	.709
27-35	.781	.736	.733	.751
36+	.847	.802	.800	.821
White				
< = 18	.712(.055)[b]	.648(.064)	.650(.058)	.666(.054)
19-26	.761(.037)	.710(.042)	.699(.033)	.715(.029)
27-35	.801(.034)	.758(.041)	.744(.033)	.758(.023)
36+	.857(.045)	.824(.054)	.822(.051)	.832(.046)
Black				
< = 18	.690(.066)	.609(.076)	.630(.073)	.631(.069)
19-26	.728(.048)	.672(.056)	.661(.051)	.689(.045)
27-35	.769(.044)	.713(.054)	.713(.049)	.733(.041)
36+	.845(.051)	.801(.065)	.799(.063)	.804(.058)
Other				
< = 18	.647(.088)	.592(.094)	.502(.094)	.510(.091)
19-26	.690(.071)	.614(.080)	.587(.076)	.633(.069)
27-35	.719(.068)	.649(.078)	.662(.071)	.677(.065)
36+	.820(.068)	.743(.087)	.766(.080)	.781(.073)
Hispanic				
< = 18	.688(.067)	.614(.076)	.624(.072)	.626(.069)
19-26	.726(.051)	.678(.058)	.659(.053)	.676(.049)
27-35	.769(.047)	.703(.057)	.714(.050)	.723(.044)
36+	.842(.054)	.784(.069)	.766(.070)	.807(.058)

[a] The proportion of all women at risk is a weighted sum of the racially specific proportions; the weights are derived from the categorically eligible population of women.

[b] Measure of the 95 percent confidence bound above and below the point estimate.

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Table E-14. Racial Weights[a] of the Total U.S. Population of Women Within 6 Months Postpartum by Age and Poverty Level

Race/Age	Income Level (% Poverty)			
	<100	100-129%	130-184%	185%+
White				
≤18 years	.492	.623	.675	.754
19-26 years	.501	.643	.723	.838
27-35 years	.479	.621	.710	.840
36+ years	.344	.373	.430	.618
Black				
≤18 years	.324	.244	.178	.129
19-26 years	.306	.182	.129	.075
27-35 years	.285	.170	.125	.067
36+ years	.375	.349	.310	.195
Other				
≤18 years	.024	.022	.021	.018
19-26 years	.035	.033	.027	.020
27-35 years	.050	.050	.040	.037
36+ years	.054	.048	.047	.050
Hispanic				
≤18 years	.159	.131	.125	.097
19-26 years	.157	.142	.121	.067
27-35 years	.185	.159	.125	.056
36+ years	.227	.229	.212	.137

[a] Racial specific weights = $W_{ijk} = (N_{ijk}) / (\sum_i N_{ijk})$

where

N_{ijk} = number of women in the ith race, jth age group, and kth income group.

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Table E-15. Racial Weights[a] of the Total U.S. Population of Children by Age and Poverty Level

Race/Age	Income Level (% Poverty)			
	<100%	100-129%	130-184%	185%+
White				
6-11 months	.460	.605	.691	.822
12-23 months	.471	.609	.699	.821
24-35 months	.474	.607	.700	.821
36-47 months	.474	.611	.695	.818
48-59 months	.471	.602	.694	.818
Black				
6-11 months	.334	.205	.152	.081
12-23 months	.331	.206	.149	.082
24-35 months	.324	.207	.152	.083
36-47 months	.323	.200	.152	.083
48-59 months	.323	.212	.155	.084
Other				
6-11 months	.037	.033	.028	.027
12-23 months	.036	.031	.027	.028
24-35 months	.035	.033	.026	.027
36-47 months	.035	.033	.027	.028
48-59 months	.036	.032	.027	.028
Hispanic				
6-11 months	.169	.156	.128	.069
12-23 months	.162	.154	.123	.068
24-35 months	.167	.152	.122	.069
36-47 months	.166	.155	.125	.071
48-59 months	.169	.154	.123	.069

[a] Racial specific weight = $W_{ijk} = (N_{ijk}) / (\sum_i N_{ijk})$

where

N_{ijk} = the number of children in the ith race, jth age group, and kth income group.

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Table E-16. Frequency of Nutritional Risk Indicators,[a] Older Infants and Children, by Age Group (NHANES-II, n=3160)

Medically Based Nutritional Risk Indicators	Age Group (in months) 6-11 (n=249)	12-23 (n=714)	24-35 (n=658)	36-47 (n=766)	48-59 (n=773)	All Children 1-5 yrs. (n=2911)
Anemia	14.3	13.5	14.8	8.6	8.4	11.3
Congenital Disorders	3.6	6.4	5.5	6.5	4.3	5.6
Freq. Respiratory or Intestinal Illness	14.6	16.8	17.9	23.3	22.9	20.1
Chronic Disorders	3.0	5.6	7.7	7.3	6.2	6.7
Underweight (wasting: <10th perc. wt/ht)	4.3	5.5	6.4	6.3	4.0	5.6
Overweight (>90th perc. wt/ht)	1.1	4.4	5.3	6.0	9.2	6.2
Stunting (<5th perc. height-for- age	9.4	12.8	10.8	13.8	14.5	13.5
Underweight (<10th perc. wt/age)	13.8	8.0	13.7	14.1	13.2	12.3
Diet-Based Nutritional Risk Indicator (food group deficiency)	–	39.8	42.0	44.6	45.9	43.1

[a] Weighted by sample weights to U.S. population frequencies.

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Table E-17. Definition of the Medical Risk "Admission Score"[a] for Children Aged 6 Months to 5 Years, Based on the Ranking of Risk Indicators by Coincident Frequency[b]

Admission Score[a]	Medically Based Risk Indicators	Incremental Number and Percentage of Children at Risk Under Successive Risk Indicators[b]	
8	Respiratory/ Intestinal Problems	622	19.7
7	Stunted (Low Ht/Age)	325	9.8
6	Anemia	271	8.3
5	Overweight (High Wt/Ht)	134	3.9
4	Underweight (Low Wt/Age)	120	3.7
3	Congenital Malformations	76	2.6
2	Chronic Conditions	50	1.4
1	Wasted (Low Wt/Ht)	31	1.1
0	Not at Medical Risk	1515	49.5

[a] Assigned ordinal measure of coincident frequency; measures relative co-occurrence of "overlap" among risk indicators. Provides an ordered categorical dependent variable for logistic regression on population characteristics.

[b] Ordered incremental frequency of occurrence (weighted by sample weights). The incremental frequencies sum to the overall proportion of the population at risk under any one or more risk criteria.

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Table E-18. Estimation of the Medical-Risk Admission Score as a function of Population Characteristics[a]

Children Aged 6 Months to 5 Years
(NHANES-II, n=3160)

Dependent Variable: Ordered Medical-Risk Admission Score

Independent Variables	Beta	Chi-Square
Intercept Terms		
Alpha 1	-0.29	3.8*
Alpha 2	-0.31	4.4**
Alpha 3	-0.35	5.5**
Alpha 4	-0.42	7.7**
Alpha 5	-0.52	11.7**
Alpha 6	-0.67	19.8**
Alpha 7	-0.84	31.5**
Alpha 8	-1.23	66.0**
Income (% Poverty)		
<100%	0.37	17.0**
100-129%	0.22	3.7*
130-184%	0.11	1.7
Age		
12-23 Months	0.27	3.8*
24-35 Months	0.33	5.5**
36-47 Months	0.45	10.2**
48-59 Months	0.42	9.1**
Race		
Black	0.03	0.1
Other	-0.32	2.3
Hispanic	-0.15	1.5
Region		
Northeast	-0.14	1.5
Midwest	-0.10	0.8
South	-0.08	0.6

[a] Logistic regression of ordered categorical variable ("admission score") on population characteristics (population weighted data).

*Significant at the 0.10 level of significance.
**Significant at the 0.05 level of significance.

Model Chi-square = 36.8 with 13 degrees of freedom.

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Table E-19. Estimated Proportion of Children Aged 6 Months to 5 Years at Nutritional Risk Based on Medical Criteria Only (NHANES II, n=3160)

Race/Age	Income Level (% Poverty) <100%	100-129%	130-184%	185%+
All[a]				
6-11 Months	.490	.458	.432	.404
12-23 Months	.560	.523	.497	.471
24-35 Months	.576	.537	.513	.486
36-47 Months	.600	.565	.540	.514
48-59 Months	.595	.561	.535	.506
6-59 Months[b]	.563	.528	.502	.475
White				
6-11 Months	.494	.464	.435	.408
12-23 Months	.566	.527	.502	.474
24-35 Months	.581	.543	.518	.489
36-47 Months	.605	.570	.545	.518
48-59 Months	.600	.566	.540	.510
6-59 Months	.568	.533	.507	.478
Black				
6-11 Months	.504	.463	.444	.412
12-23 Months	.571	.538	.508	.480
24-35 Months	.587	.544	.522	.492
36-47 Months	.612	.580	.548	.521
48-59 Months	.607	.569	.547	.516
6-59 Months	.575	.539	.514	.484
Other				
6-11 Months	.439	.403	.374	.351
12-23 Months	.494	.470	.444	.408
24-35 Months	.510	.485	.447	.421
36-47 Months	.538	.496	.487	.450
48-59 Months	.529	.507	.470	.432
6-59 Months	.499	.471	.443	.411

[a] The proportion of all U.S. children at risk is a weighted sum of the racially specific proportions; the weights were derived from the categorically eligible WIC population of children (Table E-15).

[b] Weighted average proportion of the age-specific proportions.

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Table E-19 (cont). Estimated Proportion of Children Aged 6 Months to 5 Years at Nutritional Risk Based On Medical Criteria Only (NHANES II, n=3160)

Race/Age	Income Level (% Poverty)			
	<100%	100-129%	130-184%	185%+
Hispanic				
6-11 Months	.464	.440	.412	.375
12-23 Months	.535	.501	.472	.445
24-35 Months	.556	.518	.490	.464
36-47 Months	.577	.542	.516	.492
48-59 Months	.573	.540	.506	.480
6-59 Months[b]	.539	.507	.478	.450

[b] Weighted average proportion of the age-specific proportions

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Table E-20. Definition of the Nutritional-Risk Admission Scores[a] for Children, Based on the Ranking of Medical and Dietary Risk Indicators by Coincident Frequency[b]

Children Aged 1 to 5 Years
(NHANES II, n=2911)

Admission Score[a]	Medical and Diet-Based Risk Indicators	Incremental Percentage of Children at Risk Under Successive Risk Indicators[b]
9	Inappropriate Dietary Pattern	43.1
8	Respiratory/Intestinal Problems	11.6
7	Stunted (Low Ht/Age)	5.7
6	Anemia	4.7
5	Overweight (High Wt/Ht)	2.0
4	Underweight (Low Wt/Age)	1.9
3	Congenital Malformations	1.6
2	Chronic Conditions	0.8
1	Wasted (Low Wt/Ht)	0.7
0	Not at Nutritional Risk	27.8
Total, at risk under any one or more criteria		72.2

[a] Assigned ordinal measure of coincident frequency; measures relative co-occurrence of "overlap" among risk indicators. Provides an ordered categorical dependent variable for logistic regression on population characteristics.

[b] Ordered incremental frequency of occurrence (weighted by sample weights). The incremental frequencies sum to the overall proportion of the population at risk under any one or more risk criteria.

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Table E-21. Estimation of the Medical-Plus-Dietary-Risk Admission Score as a Function of Population Characteristics[a]

Children Aged 1 to 5 Years
(NHANES II, n=2911)

Dependent Variable: Ordered Nutritional-Risk Admission Score

Independent Variables	Beta	Chi-Square
Intercept Terms		
Alpha 1	0.80	45.2**
Alpha 2	0.78	43.0**
Alpha 3	0.75	39.7**
Alpha 4	0.71	35.4**
Alpha 5	0.65	29.2**
Alpha 6	0.55	21.1**
Alpha 7	0.45	14.5**
Alpha 8	0.25	4.3**
Alpha 9	0.01	0.1
Income (% Poverty)		
<100%	0.20	4.7**
100-129%	0.28	5.3**
130-184%	0.10	1.1
Age		
24-35 Months	-0.00	0.00
36-47 Months	0.16	2.6
48-59 Months	0.18	3.4*
Race		
Black	0.29	7.8**
Other	-0.41	3.5*
Hispanic	-0.01	0.0
Region		
Northeast	-0.30	6.6**
Midwest	-0.00	0.0
South	0.13	1.4

[a] Logistic regression of ordered categorical variable ("admission score") on population characteristics (population weighted data).

*Significant at 0.10 level of significance.
**Significant at 0.05 level of significance.

Model Chi-square = 56.3 with 12 degrees of freedom.

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Table E-22. Estimated Proportion of Children at Nutritional Risk Based on Medical and Dietary Criteria Combined

Children Aged 1 to 5 Years
(NHANES II, n=2911)

Race/Age	Income Level (% Poverty) <100%	100-129%	130-184%	185%+
All[a]				
12-23 Months	.747	.751	.715	.690
24-35 Months	.753	.744	.715	.687
36-47 Months	.772	.786	.744	.721
48-59 Months	.777	.782	.754	.729
12-59 Months[b]	.761	.764	.733	.707
White				
12-23 Months	.730	.740	.706	.686
24-35 Months	.739	.740	.707	.684
36-47 Months	.761	.778	.738	.717
48-59 Months	.764	.773	.748	.726
12-59 Months	.748	.756	.724	.703
Black				
12-23 Months	.787	.807	.771	.755
24-35 Months	.794	.773	.778	.747
36-47 Months	.813	.835	.793	.778
48-59 Months	.820	.832	.795	.792
12-59 Months	.804	.811	.785	.767
Other				
12-23 Months	.639	.663	.622	.586
24-35 Months	.651	.662	.621	.597
36-47 Months	.684	.675	.659	.631
48-59 Months	.684	.703	.690	.655
12-59 Months	.665	.676	.647	.616
Hispanic				
12-23 Months	.739	.739	.719	.704
24-35 Months	.732	.740	.710	.682
36-47 Months	.746	.772	.736	.732
48-59 Months	.760	.779	.754	.719
12-59 Months	.744	.758	.730	.708

[a] The proportion of all U.S. children at risk is a weighted sum of the racially specific proportions; the weights were derived from the categorically eligible WIC population of children.

[b] Weighted average proportion of age-specific proportions.

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Table E-23. Coincident Frequency of Medically Based Nutritional Risk Indicators From NHANES-II Sample of Children, Ages 6 months - 5 years (n=3160)

Indicator	n	%
No Risk Indicator Present	1487	44.49
Presence of One Risk Indicator	1058	31.70
Respiratory/Intestinal Infections	319	9.54
Chronic Conditions	47	1.41
Renal Disorders	16	0.47
Congenital Malformations	52	1.56
Tall Stature	120	3.59
Underweight (wt/age)	57	1.71
Stunting	106	3.17
Underweight (wasted, wt/ht)	24	0.72
Overweight (wt/ht)	108	3.23
Anemia	209	6.25
Presence of Two Risk Indicators	539	16.09
Resp./Int. Infec. & Chronic Conditions	46	1.38
Resp./Int. Infec. & Renal Disorders	2	0.16
Resp./Int. Infec. & Congenital Malform.	18	0.54
Resp./Int. Infec. & Tall Stature	23	0.69
Resp./Int. Infec. & Underweight	7	0.21
Resp./Int. Infec. & Stunting	29	0.87
Resp./Int. Infec. & Low Wt/Ht	10	0.30
Resp./Int. Infec. & Overweight	20	0.60
Resp./Int. Infec. & Anemia	44	1.32
Chronic Conditions & Renal Disorders	1	0.03
Chronic Conditions & Congenital Malform.	12	0.36
Chronic Conditions & Tall Stature	3	0.09
Chronic Conditions & Underweight	1	0.03
Chronic Conditions & Stunting	12	0.36
Chronic Conditions & Low Wt/Ht	2	0.06
Chronic Conditions & Overweight	10	0.30
Chronic Conditions & Anemia	14	0.42
Renal Disorders & Congenital Malform.	3	0.09
Renal Disorders & Tall Stature	3	0.09
Renal Disorders & Underweight	2	0.06
Renal Disorders & Overweight	3	0.09
Renal Disorders & Anemia	1	0.03

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Table E-23. Coincident Frequency of Medically Based Nutritional Risk Indicators From NHANES-II Sample of Children, Ages 6 months - 5 years (n=3160)

Indicator	n	%
Congenital Malform. & Tall Stature	5	0.15
Congenital Malform. & Underweight	3	0.09
Congenital Malform. & Stunting	5	0.15
Congenital Malform. & Overweight	3	0.09
Congenital Malform. & Anemia	9	0.27
Tall Stature & Underweight (wt/ht)	9	0.27
Tall Stature & Overweight	18	0.54
Tall Stature & Anemia	4	0.12
Underweight & Stunting	116	3.47
Underweight & Wasted (wt/ht)	52	1.56
Underweight & Anemia	10	0.30
Stunting & Overweight	7	0.21
Stunting & Anemia	16	0.48
Underweight & Anemia	4	0.12
Overweight & Anemia	12	0.36
Presence of Three Risk Indicators	193	5.77
Resp./Int., Chronic Cond., Renal Dis.	1	0.03
Resp./Int., Chronic Cond., Cong. Mal.	9	0.27
Resp./Int., Chronic Cond., Tall Stature	2	0.06
Resp./Int., Chronic Cond., Underweight	2	0.06
Resp./Int., Chronic Cond., Overweight	6	0.18
Resp./Int., Chronic Cond., Anemia	6	0.18
Resp./Int., Renal Dis., Cong. Mal.	2	0.06
Resp./Int., Renal Dis., Tall Stature	2	0.06
Resp./Int., Renal Dis., Underweight	1	0.03
Resp./Int., Renal Dis., Anemia	1	0.03
Resp./Int., Cong. Mal., Stunting	4	0.12
Resp./Int., Cong. Mal., Anemia	1	0.03
Resp./Int., Tall Stature, Underweight	4	0.12
Resp./Int., Tall Stature, Overweight	5	0.15
Resp./Int., Tall Stature, Anemia	2	0.06
Resp./Int., Underweight, Stunting	33	1.00
Resp./Int., Underweight, Wasted	11	0.33
Resp./Int., Stunting, Overweight	2	0.06
Resp./Int., Stunting, Anemia	2	0.06
Resp./Int., Underweight, Anemia	1	0.03
Resp./Int., Overweight, Anemia	2	0.06

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Table E-23. Coincident Frequency of Medically Based Nutritional Risk Indicators From NHANES-II Sample of Children, Ages 6 months - 5 years (n=3160)

Indicator	n	%
Chronic Cond., Cong. Mal., Tall Stature	3	0.09
Chronic Cond., Cong. Mal., Underweight	1	0.03
Chronic Cond., Underweight, Stunting	9	0.37
Chronic Cond., Underweight, Wasted	1	0.03
Chronic Cond., Underweight, Anemia	1	0.03
Chronic Cond., Tall Stature, Underweight	1	0.03
Chronic Cond., Tall Stature, Anemia	1	0.03
Chronic Cond., Stunting, Overweight	1	0.03
Chronic Cond., Stunting, Anemia	1	0.03
Chronic Cond., Overweight, Anemia	1	0.03
Renal Dis., Cong. Mal., Tall Stature	1	0.03
Renal Dis., Cong. Mal., Underweight	1	0.03
Renal Dis., Cong. Mal., Wasted	1	0.03
Renal Dis., Cong. Mal., Overweight	2	0.06
Renal Dis., Underweight, Stunting	2	0.06
Cong. Mal., Tall Stature, Wasted	1	0.03
Cong. Mal., Tall Stature, Anemia	1	0.03
Cong. Mal., Underweight, Stunting	9	0.27
Cong. Mal., Underweight, Wasted	4	0.12
Cong. Mal., Underweight, Anemia	1	0.03
Cong. Mal., Wasted, Anemia	2	0.06
Tall Stature, Overweight, Anemia	2	0.06
Stunting, Wasted, Anemia	1	0.03
Stunting, Overweight, Anemia	2	0.06
Underweight, Stunting, Wasted	17	0.51
Underweight, Stunting, Anemia	18	0.54
Underweight, Wasted, Anemia	9	0.27
Presence of Four Risk Indicators	49	1.47
Resp./Int., Chron. Cond., Ren. Dis., Tall Stature	1	0.03
Resp./Int., Chron. Cond., Cong. Mal., Tall Stature	1	0.03
Resp./Int., Chron. Cond., Underweight, Stunting	6	0.18
Resp./Int., Chron. Cond., Underweight, Wasted	2	0.06
Resp./Int., Chron. Cond., Tall Stature, Overweight	1	0.03

Table E-23. Coincident Frequency of Medically Based Nutritional Risk Indicators From NHANES-II Sample of Children, Ages 6 months - 5 years (n=3160)

Indicator	n	%
Resp./Int., Chron. Cond., Stunting, Anemia	1	0.03
Resp./Int., Cong. Mal., Underweight, Stunting	2	0.06
Resp./Int., Cong. Mal., Stunted, Overweight	1	0.03
Resp./Int., Cong. Mal., Stunted, Wasted	1	0.03
Resp./Int., Underweight, Stunting, Anemia	5	0.15
Chron. Cond., Renal Dis., Underweight, Wasted	1	0.03
Chron. Cond., Cong. Mal., Underweight, Stunting	2	0.06
Chron. Cond., Cong. Mal., Underweight, Wasted	2	0.06
Chron. Cond., Cong. Mal., Tall Stature, Wasted	1	0.03
Chron. Cond., Underweight, Stunting, Wasted	3	0.09
Chron. Cond., Underweight, Stunting, Anemia	1	0.03
Chron. Cond., Cong. Mal., Overweight, Anemia	1	0.03
Chron. Cond., Tall Stature, Overweight, Anemia	1	0.03
Renal Dis., Cong. Mal., Underweight, Stunting	2	0.06
Renal Dis., Underweight, Stunting, Anemia	1	0.03
Cong. Mal., Underweight, Stunting, Wasted	2	0.06
Cong. Mal., Underweight, Stunting, Anemia	2	0.06
Tall Stature, Underweight, Wasted, Anemia	1	0.03
Underweight, Stunting, Wasted, Anemia	2	0.06

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Table E-23. Coincident Frequency of Medically Based Nutritional Risk Indicators From NHANES-II Sample of Children, Ages 6 months - 5 years (n=3160)

Indicator	n	%
Presence of Five Risk Indicators	14	0.42
Resp./Int., Chron. Cond., Cong. Mal., Underweight, Stunting	2	0.06
Resp./Int., Chron. Cond., Cong. Mal., Stunting, Anemia	1	0.03
Resp./Int., Chron. Cond., Underweight, Stunting, Anemia	1	0.03
Resp./Int., Chron. Cond., Underweight, Stunting, Wasted	2	0.06
Resp./Int., Cong. Mal., Underweight, Stunting, Wasted	2	0.06
Resp./Int., Cong. Mal., Underweight, Stunting, Anemia	1	0.03
Resp./Int., Underweight, Stunting, Wasting, Anemia	1	0.03
Chron. Cond., Cong. Mal., Underweight, Stunting, Wasted	1	0.03
Renal Dis., Underweight, Stunting, Wasting, Anemia	1	0.03
Resp./Int., Chron. Cond., Cong. Mal., Overweight, Anemia	2	0.06
Presence of Six Risk Indicators	1	0.03
Resp./Int., Renal Dis., Cong. Mal., Underweight, Stunting, Wasted	1	0.03
Presence of Seven Risk Indicators	1	0.03
Resp./Int., Chron. Cond., Renal Dis., Cong. Mal., Underweight, Stunting, Wasted	1	0.03

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Table E-24. Frequency of Nutritional Risk Indicators[a]

Infants under 6 Months Old
(National Natality Survey, n=7484)

Risk Indicator	Percent at Risk
Infant deemed at risk because mother was medically at risk during pregnancy	71.7
Congenital Malformations	1.3
Low Birth Weight	5.9
Multiple Birth	1.0
Infant at risk, excluding mother's risk status	7.9
Not at nutritional risk	27.0

[a] Weighted population frequencies.

Table E-25. Definition of the Medical-Risk Admission Score[a] for Infants Aged 0-6 Months

(National Natality Survey, n=7484)

Admission Score	Risk Indicator	Percent at Risk
2	Infant at risk because mother was medically at risk during pregnancy	71.7
1	Congenital malformations	1.3
0	Not at nutritional risk	27.0

[a] See Table E-6, E-11, E-17, or E-20 for definition.

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Table E-26. Estimation of Medical-Risk Admission Score Based on Medical Criteria and Mother's Eligibility as a Function of Population Characteristics

Infants Under 6 Months Old
(National Natality Survey, n=7484)

Dependent Variable: Ordered Medical-Risk Admission Score

Independent Variables	Beta	Chi-Square
Intercept		
Alpha 1	0.88	304.0**
Alpha 2	0.81	262.1**
Income (% Poverty)		
<100%	0.15	2.6*
100-129%	-0.09	0.8
130-184%	-0.12	3.1*
Race		
Black	-0.06	0.4
Other	-0.39	7.3**
Hispanic	-0.16	2.6*
Region		
Northeast	0.11	2.4
North Central	0.27	16.1**
South	0.32	19.5**

*Significant at the 0.10 level of significance.

**Significant at the 0.05 level of significance.

Model Chi-square = 41.44 with 9 degrees of freedom.

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Table E-27. Estimated Proportion of Infants Under 6 Months Old at Nutritional Risk Based on Medical Criteria and Mother's Eligibility (NNS, n=7484)

Racial Group	Income Level (% Poverty)			
	<100%	100-129%	130-184%	185%+
All	.750	.706	.704	.733
White	.766(.034)[a]	.721 (.041)	.715 (.031)	.739 (.021)
Black	.738 (.045)	.686 (.054)	.684 (.048)	.718 (.104)
Other	.702 (.068)	.639 (.076)	.631 (.072)	.674 (.064)
Hispanic	.738 (.048)	.688 (.055)	.687 (.049)	.709 (.043)

[a] 95% confidence bounds above and below the point estimate.

Table E-28. Definition of the Nutritional-Risk Admission Score for Infants Under 6 Months Old Based on their Medical Criteria Only (Excluding the Risk Status of the Mother)

(National Natality Survey, n = 7484)

Admission Score	Risk Indicator	Percent at Risk
3	Low Birth Weight	5.9
2	Congenital Malformations	1.3
1	Multiple Birth	0.7
Total, at risk on	any one or more criteria	7.9
0	Not at Nutritional Risk	92.1

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Table E-29. Estimation of the Nutritional-Risk Admission Score for Infants Under 6 Months Based on Medical Criteria as a Function of Population Characteristics

(National Natality Survey, n = 7484)

Dependent Variable: Ordered Medical-Risk Admission Score

Independent Variables	Beta	Chi-Square
Intercept	-2.53	860.1**
Income (% Poverty)		
<100%	0.34	6.6**
100-129%	0.19	1.4
130-184%	-0.13	1.1
Race		
Black	0.47	11.7**
Other	-0.08	0.1
Hispanic	0.14	0.8
Region		
Northeast	-0.03	0.0
North Central	0.04	0.1
South	-0.09	0.5

*Significant at the 0.10 level of significance.

**Significant at the 0.05 level of significance.

Model Chi-square = 26.46 with 9 degrees of freedom.

Table E-30. Estimated Proportion of Infants Under 6 Months Old at Nutritional Risk Based on Infant's Medical Criteria Only[a]

(National Natality Survey, n= 7484)

Racial Group	Income Level (% Poverty)			
	<100%	100-129%	130-184%	185%+
White	.100 (.038)[b]	.087 (.036)	.065 (.015)	.073 (.010)
Black	.152 (.048)	.134 (.050)	.100 (.032)	.113 (.030)
Other	.091 (.041)	.079 (.048)	.059 (.035)	.066 (.035)
Hispanic	.112 (.045)	.098 (.042)	.072 (.025)	.082 (.032)

[a] Based on limited number of risk indicators: low birth weight, multiple births and congenital malformations as risk criteria for infants. Since many important risk indicators for infants are omitted here, these resulting estimates are an underestimation.

[b] 95 percent confidence bound above and below the point estimate.

* U. S. GOVERNMENT PRINTING OFFICE: 1988-201-095:30090